THE TELEGRAPHIC JOURNAL AND
Electrical Review.
VOL. XXIII.—No. 558.

PASSENGER AND GUARD COMMUNICATION IN RAILWAY TRAINS.

WE were pleased in our last week's issue to be able to find space to direct attention to the experiences of "Pro Bono Publico" when travelling with some undesirable companions on the London and North Western Railway. Subsequent letters from various correspondents appearing in our daily contemporaries have widened the field of complaint, and there can be little, if any, doubt that there are numbers of folks subjected to the insults, and the gross and foul language complained of, who, from various causes, refrain from making their case heard—who, in fact, are but too glad to escape into another carriage, and so avoid any further encounter with their tormentors. Whether by so doing they act wisely is a question we are hardly qualified to answer. We think, however, that for the public good such a course is not desirable. Men or women in an irresponsible condition should not be allowed to enter compartments of railway carriages at all, unless under the charge of a responsible agent. It would seem that this law is not so thoroughly recognised as it should be, especially on some lines, but where a matter so necessary for the comfort, if not even for the safety of the passenger, is so disregarded, surely some consideration should be exhibited on the part of the officials whose duty it is to see passengers properly seated, such as would avoid individuals the worse for drink, or otherwise equally irresponsible for their good behaviour, being thrust in amongst women and children. Where such is observed not to be the case, we do think that it is the duty of everyone to direct the attention of a responsible official to the matter. Without complaint, railway companies may fairly conclude that their arrangements are perfect. We scarcely think railway companies do conclude that the "rope communication," which they have generally adopted, is efficient or even moderately satisfactory; still, whatever may be their conclusions, the experience of the public with respect to it should not be withheld. Every failure, every occasion on which it is required for use and not found to be available, and every case in which passengers unfit to travel are thrust in upon others contrary to their wishes, should be brought under the notice of the company concerned.

The coroner's jury on the recent accident on the Manchester, Sheffield, and Lincolnshire Railway, in finding their verdict directed attention to the necessity of providing all trains with an electrical communication between passengers and the officials in charge of the train. We shall not attempt to analyse this accident to show how far the use of such a mode of communication would have been of service in this case in saving life. The distance the passenger train ran after the accident to the axle became evident to the inmates of the carriage on which it occurred was not, we are aware, great. The time was short, but when we come to consider that, with the aid of the improved brakes of the present day, trains may be brought to a stand within a distance of their own length, there can be little doubt that a ready and powerful means of communication might have proved of good service. Not only would such a communication have been available from the interior of the coach, but there is every probability that, properly fitted, the lurch of the vehicle at the moment the axle broke would have automatically—by severing the connection with the adjoining vehicle—given the required signal to the officials.

It is not improbable that the notice taken of the circumstance by the jury may have the effect of directing attention to the question once more. If so, there can be no doubt of the issue. One scarcely realises that 20 years have passed since an Act of Parliament was passed providing that on and from the 1st of April, 1869, every train travelling over 20 miles without stopping, should be fitted with a means of communication between the passengers and guards of the train! Yet it is so. In 1869 the Board of Trade allowed the *cord* system to be adopted *conditionally*. In 1871, Sir Henry (then Captain) Tyler, M.P., reported the result of the working of the system as hardly economical, although cheap in first cost; and in 1872 he reported it as unsatisfactory.

The system has thus been condemned from beginning to end. It was, no doubt, unfortunate that the Board of Trade accepted it—even conditionally—in the first place. Undoubtedly railway companies would find a grievance in being compelled to lay aside one system for another soon after its adoption. But time has now passed on, and it is probable that railway companies would be found more willing to consider the question again if fairly brought before them. That they would find it worth their while we feel satisfied. The present mode is one which entails upon them a continual outlay—a heavy annual charge, much more than would go to cover the interest on the outlay required for the provision of an electrical communication. This is a point which may easily be determined. Let the companies, those who use an electrical and those who still use the cord system, compare notes as to the cost. We have little fear as to the result. Although electrical systems will possibly fail in railway trains as in other applications, it will afford a means of communication immensely superior to and far more reliable than the cord system; and the day is not, we believe, far distant when these views will be recognised and adopted by the leading lines of the kingdom.

JOHN H. ALLEY, the Secretary of the New England Western Electric Light Company, may be classed in the category of those who rush in where angels fear to tread. In a communication to the editor of *Modern Light and Heat* this sapient gentleman says:—"I notice in the London ELECTRICAL REVIEW of July 6th, an article on 'the working of the underground railway by means of electric accumulators as simply ridiculous,' and going on to say, 'they would not be surprised to have this brilliant proposal followed by one to run the whole fleet of Atlantic liners by accumulators, &c.' The tone of an article in the Boston *Herald* of to-day is of the same tenor." He there and then makes it known that the sole reason for these comments is because no one has been able to put into use with accumulators, a motor of sufficient economy to do its work effectually, and he then flies off at a tangent to give the startling information that his company has been running a *car* for more than a year with 120 accumulator cells. Mr. Alley evidently surmises that we have tried nothing of the kind in this played out old country, and that we are therefore quite unaware of what may or may not be done with secondary batteries. Still as we commented in our article upon 600 H.P. locomotives and not upon street cars, we fail to see the force of his reasoning. His views upon the efficiency of electro-motors need no comment, but we cannot refrain from quoting his closing sentence, which is evidently heartfelt, and with which, although not in strict accordance with the rules of grammar, we cordially agree :—"There is lots of dust thrown into the air to cover incompetency."

WE said in our last issue that the makers of lead covered cables would find some crumbs of comfort in the experiences of Mr. Sunny which were related in the same number. We now hear that the conductors manufactured by John Fowler & Co., of Leeds, are quietly forcing their way to the front, and that in no instance has any complaint arisen. We have ourselves seen very complimentary and flattering testimonials of their excellence, both electrically and mechanically, from well known firms in this country, and also from America.

THE importance of clean tracks for tramcars is clearly shown in Mr. Reckenzaun's article this week. His experiences in America on this point naturally correspond with those which have fallen to the lot of our own pioneers in electric traction, and Mr. Elieson, we are sure, could unfold many a tale of woe pertinent to this point alone.

THE simple system of magneto electric bells just brought out by Messrs. Cox-Walker and A. A. Campbell Swinton appears to be a very good one. If the transmitter were so constructed as to render the to and fro motion of the armature independent of hand pressure, as is the case with some electric light switches which go over sharply by the aid of a spring after the handle has been turned through a certain angle, it would be perfect. As it is signals cannot be absolutely relied upon without applying to the knob a definite strength of movement.

"WOODITE is a highly elastic improved India-rubber compound, possessing properties hitherto unattained." So runs the prospectus of the Woodite Company, which has been formed for the purpose of buying up the patents of Mrs. A. M. Wood. The number of uses to which this material can be put seems to indicate a considerable demand for it, but we do not notice any suggestion of its application to electrical work. On the face of the prospectus we think that something could be done with the improved compound, and we should like to know whether any of our readers have tried it for purposes connected with electrical manufactures.

MESSRS. BOOTH, ELLSON & CO., of Melbourne, have published a brochure on electric tramways. It does not profess to deal exhaustively with the subject of the electrical transmission of power, but only as showing its adaptability to tramcar locomotion. The firm has already been mentioned in our pages as a pioneer in this direction, and we shall be pleased to think that the little book to which we have referred may be the means of developing electric traction in the colonies. Press notices of the tramcar trials which have taken place in this country are copiously extracted, and these alone should be sufficient to excite such interest in the subject as to lead to deeper and more careful enquiry.

AT a meeting of the Royal Commission appointed to enquire into the doings of the Metropolitan Board of Works, Mr. George Edwards, late deputy chairman of that Board, said that he "used to read between the lines," that for years he had suspected Mr. Robertson "from his extravagant living," and that he "wanted to know where he got the money from to live at the rate he did." If this is to be the regulation standard we think there are many men who require to be re-measured, especially some of the servants employed in limited liability companies, who certainly are living and comporting themselves in a way not justified by the amount of their salary.

REFERRING to the paragraph that appeared in some of the daily papers last week of the restoration to sight through a flash of lightning at Wolverhampton of a collier who some time ago lost his sight through an accident, we think that this is a matter which should occupy the attention of those medical gentlemen who are interested in the application of electricity for curative purposes. Some time back Dr. Lawrence was trying some very interesting experiments with regard to reducing the thickening of the albumen of the eye by passing light currents of electricity through the ball to reduce it to a fluid. He tried his experiment by heating in water the white of an egg, and after having caused it to set re-liquified it with great success by passing currents through it. The medical profession might now institute a series of experiments upon the influence of electric shocks in cases of partial or total blindness, and we will undertake to say that the results would make the study well worth pursuing. We believe that Mr. Spagnoletti, the genial past-president of the Society of Telegraph-Engineers and Electricians, could relate many instances of remarkable cures of various maladies by a more or less prolonged application of the electric current, obtained, of course, from a powerful galvanic source, and not from a useless "electropathic" belt such as we described some six months ago.

PERHAPS the most exhaustive paper yet written upon the subject of electrical railways is that which Mr. F. J. Sprague recently read in the States, an abstract of which we publish this week. There are, of course, many points in the very lengthy compilation of Mr. Sprague which apply to existing American institutions only, and which, therefore, although highly interesting and valuable, would be out of place here ; but the most important items which are calculated to appeal forcibly to our commercial element have found a place in our columns. We do not mean to say that these abstracts are not equally interesting to the scientist, but it is to business men that we must look for the development of electric traction, and these gentlemen care more for figures and balance sheets than for a learned discourse upon an electric locomotion "system."

THE work which Mr. Sprague has accomplished in Richmond, Va., will set at rest all doubts which have been raised as to the feasibility of running any number of cars on the same electric track, and on another point also the eminent American electrician has gone right away from the beaten track in suggesting what to most people will seem to be the height of rashness. He not only allows the motor to remain entirely uncovered below the car, but he proposes to clean the motors by washing them down with a hose to remove the accumulated mud. If Mr. Sprague can do so without injury to the apparatus he will have accomplished a great step in the advancement of the electric motor for every-day, and especially for tramway use. We do not, however, believe that these apparatus, as constructed on this side, would bear such a drenching without breaking down entirely, although, after all, it may be that we don't know what can be done until we try. Mr. Sprague deserves every encouragement to persevere in the admirable work he has set himself, and we tender him our best wishes for still greater success.

THE report of the London Street Tramways Company announces a dividend of 4 cent. per annum, as against 8 per cent. at the corresponding period of last year. Forage has been dearer, the mortality amongst the horses has been in excess of the average, and there are also other reasons to account for this unsatisfactory state of the company's finances. The only way open to recover lost ground is to boldly go in for electric traction. Electro-motors do not give up the ghost readily, coals will not vary in price like forage, which, after the terrible weather of the past few months, will certainly become still more costly, and Mr. Sprague's American experience clearly shows a vast saving over horse-flesh by the employment of electricity. With the mileage now made on the Richmond line, £25 per day is saved in motive power expenses alone. It is hardly necessary, says the author, to point out that this means a good interest on a pretty large investment. We commend to the notice of the directors and shareholders of the London Street Tramways Mr. Sprague's paper on "The Solution of the Municipal Rapid Transit Problem," to be found on p. 117 of this issue.

EDISON, the adapter, ought to think well of his friend Colonel Gouraud. Enough sensational rubbish has been written about the phonograph to satisfy even the "Wizard of Menlo Park," and so long as the feverish excitement which the transportable phonograms have occasioned is confined to the United States, well and good. But as it is commonly supposed that no smoke can exist without the proximity of fire, so it would seem that the astounding interviews which the representatives of the daily press have had with the clever Colonel are not devoid of meaning. If, however, there are any persons in this country who believe that the phonograph can be made the basis of successful commercial speculation here, we are decidedly of the opinion that they will be woefully deceived. All the tall talking in the world will not convince us that Edison's phonograph, or rather his adaptation of another man's experiments, supplies a want in this country. Very few business men, we imagine, would prefer a phonogram to a letter authenticated with the known signature of the writer, and the arguments which might be urged against the use of the apparatus here would certainly outweigh anything which could be advanced in its favour. Matters relating to the American business do not appear to progress so smoothly as we have been led to believe, for, says the gallant Colonel, in an apologetic letter to the *Daily News* of Tuesday, "The 'many complaints' of an impatient public are perhaps the greatest compliment that could be paid the distinguished inventor." We should have thought differently, and we hope that Mr. Edison will appreciate the compliment.

NUMEROUS designs of mechanical gearing for transmitting the power of an electric motor to car axles have been devised, but their number seems inexhaustible; all kinds of well known mechanical devices are being adapted to purposes of car propulsion, and when any part of such gearing is attached to the spindle of a dynamo or electric motor, it becomes a "system" of electric traction. Thus, by an endless variation in the shape, size, or relative adjustment of wheels, belts, ropes, pullies, cranks or levers, connected directly or indirectly to an armature, we obtain an endless variety of "electric tramway systems," for each of which is claimed advantages over every other. One of the most recent and "novel" methods of connecting a motor to a pair of axles is that of Mr. Elias Ries, of Baltimore, who has from time to time advanced several schemes relating to street car propulsion. The present arrangement, which is the subject of a patent in the United States, consists of two small bevel wheels attached to the ends of the armature spindle of a motor; these gear into a pair of larger bevel wheels fastened to the car axles. The motor is suspended centrally upon frames which are carried by the axles. Mr. Ries claims that this "connection between the armature shaft of the motor and the driving wheels is a *direct and positive one*, and that it dispenses entirely with the use of counter shafts, ropes, belts, sprocket wheels, chains, connecting rods, worm gear and the like, all of which are objectionable to a greater or less extent, and especially so for this class of service." What a wonderful discovery! "Another important advantage," says *Modern Light and Heat*, "of this mode of mounting is that the tractive effect of *all* the wheels of the car is obtained from the armature shaft of a single motor." Mr. Ries seems to have solved the problem of driving a pair of axles by means of an armature and four toothed wheels, and our contemporary predicts that this invention or discovery (?) "will doubtless receive considerable attention at the hands of those interested in the subject of electric street railways."

WE are glad to see that the *Electrician* is of the same opinion as ourselves with regard to the mad-brained scheme of running 600 H.P. electric locomotives by means of accumulators on the underground railway. Our contemporary has considerably over estimated the weight of batteries which would be necessary for the purpose, but that is of little consequence so long as it condemns the proposed method of operating. It is bad enough, indeed, to find year after year so little progress made, but it would be doubly sad to see electric traction seriously retarded and possibly irremediably affected by the failure of a visionary idea which has not one redeeming feature, and which is bound to end in disaster. It is not perhaps too late to retract and save the greater portion of £6,000.

A SYNTHETIC STUDY OF DYNAMO MACHINES.

I.—INDUCTION.

THE facts of induction brought to light by the researches of Michael Faraday half a century ago form the basis on which all dynamo machines are constructed. Briefly let us set in order these facts.

1. *Currents induced by currents.*—In fig. 1 a coil, A, is placed in circuit with a battery, B, and a key, K, the two faces of the coil designated *a* and *b* respectively. The connections to the battery are such that when the circuit is completed a current will flow in the direction of the arrow. Let a second coil, C, be placed parallel to the first, the faces of which are called *c* and *d*. The ends of this coil are connected by flexible wires to the terminals of a galvanometer, G, the direction of the current through the latter being known from the direction in which its needle deflects. When the coils are in the position shown, let K be depressed and kept down. On closing the circuit the galvanometer needle will be observed to deflect. But it will not take up a permanent position of deflection. It will immediately return, showing that the current producing the deflection is but momentary. After a few swings the needle will return to zero. The deflection of the needle is due, we say, to an *induced* current in C, arising from an E.M.F. created in it which has for its obvious cause the starting of the current in A. From the direction in which the needle deflects, we know that the current in C is in the *opposite* direction to that of the current in A.

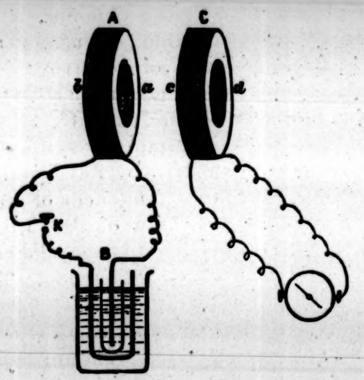


FIG. 1.

But the needle has come to rest though the current still flows in A. Break the circuit, and again there is a deflection of the same momentary character, but this time in an opposite direction. The current in C now flows in the same direction in which it has been flowing in A. From these experiments we learn that the induced E.M.F. is not due to a steady current in A but to a *change in the magnitude of the current.* So long as the current flowed steadily, the needle remained at rest; it was only when the circuit was broken that it deflected. Here the current was reduced to 0, but a partial diminution would have had a similar effect though in a less degree.

Turn the coil, A, round so that its faces, *a* and *b*, are reversed and repeat the experiments. The current in A now flows in a direction opposed to its former direction, considered relatively to C, and the starting and stopping of the current will give rise to momentary currents in C also in directions opposed to their former directions. But note that the current in C still flows in an opposite direction to the current in A when the latter is started and in the same direction when it is stopped. The direction of the induced current depends then upon the direction of the inducing current, and if the latter is reversed all the observed effects are of an opposite character.

Suppose A to be placed so that its face, *a*, is towards the reader (fig. 2). Let it remain in that position with the current from the battery flowing through it. Place C immediately in front of A, faces *a* and *c* being adjacent, and when the galvanometer needle comes to zero move to the left, 1, again to the right, 2, next up 3, and lastly down 4. In each case we get a deflection in the same direction as the current in A. From each of the four positions bring C up to its position in front of A, the deflection in each case is in an opposite direction. We conclude that the movement of the coil from A produces the same result as stopping the current while the movement towards A is equivalent to starting the current. Turn A round with face *b* towards the reader and repeat the experiment. In every case the momentary current will flow in an opposite direction though in the same direction relatively to A.

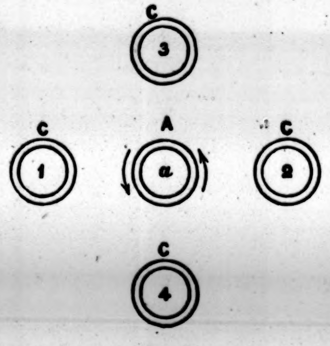


FIG. 2.

2. *Currents induced by magnets.*—Let an ordinary bar magnet (fig. 3) be substituted for the coil A, its north and south poles being marked N and S respectively. By north pole is here meant the end which would point to the north if the magnet were free to adjust itself directionally according to the earth's magnetism. The coil, C, is situated immediately in front of the N pole in position (1) and the needle is at rest. We move it to the left (2) and we get a momentary current. Again we move it to the right (3), now up (4), now down (5), lastly to position (6), which is still in front of the magnet, but at a considerable distance from it. In each case the current flows in coil C in the same direction, as shown by the arrows. Let us reverse the magnet, turning its N and S poles end for end. The currents in C will now flow in a direction opposite to their first path. No matter whether C is near to or far from the magnet, it is only when relative motion of magnet and coil occurs that a current is produced. It is quite immaterial whether the coil or the magnet makes the actual movement, but relative motion must take place before an E.M.F. is induced in C.

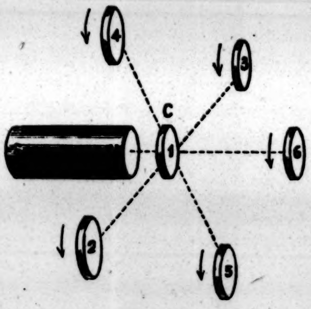


FIG. 3.

3. *Coils and magnets are interchangeable.*—We can now with these experimental data to hand generalise a little. First, we found when a steady current was

flowing in A that bringing C up to it produced in the latter a similar result to starting the current in A when both coils were at rest, or, in other words, starting a current in A is the same as bringing C up with great rapidity. Similarly we found that stopping the current was equivalent to removing C very rapidly. Next comparing the results illustrated by figs. 2 and 3, we find that the magnet, S, N, acts exactly like the coil, A, when a current flows in the latter in the direction of the arrow, fig. 1. If we have a coil in which looking at one of its faces the current flows in the direction of the hands of a watch, that face behaves exactly like the S pole of a bar magnet, while if the current flows in a direction opposite to that of the hands of a watch the face behaves like a N pole. As a matter of fact, had we been so minded we might have thrust through the coil, A, a bar of soft iron, fig. 4, which would have been converted into a magnet by the current flowing round it. All the experiments might then have been repeated, producing effects similar in character though greater in degree. We should then have had an electro-magnet with its poles as shown in fig. 4, instead of the bar magnet in fig. 3.

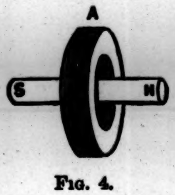


Fig. 4.

Thoughout these experiments there has been no actual contact of C and A. The E.M.F. induced in C has been caused by some influence in the *vicinity* of the coil, A, or the bar magnet, S, N, or the soft iron thrust through A. Call it action at a distance, or what we please, it is to some cause *outside* the coils or magnet that the phenomena are due, and our next business will be to explore the space in which the induction takes place.

(*To be continued.*)

THE GRAPHOPHONE.

By CHARLES SUMNER TAINTER.

In a paper on the phonograph read by Mr. E. T. Gilliland before the New York Electric Club on May 12th, 1888, and published in the *Electrical World* of May 19th, there are certain statements to which I take exception, as they are not supported by the facts in the case.

Mr. Gilliland says: "Mr. Edison invented, patented, and described in print all the essentials of the present phonograph instrument ten years ago." And that "every principle embraced in the present improved phonograph is shown and described in these patents."

The manifest object of these statements is, of course, to create the impression in the public mind that the present development of the art of recording and reproducing sounds is due entirely to the work of Mr. Edison; that the "essentials" are covered by his patents vaguely alluded to as "The patents of 1878," and that any other apparatus having the same object, and employing those "essentials" are "infringing machines," and, therefore, to be avoided by the public.

It is very important to all who will have occasion to use machines of this nature, either for business or pleasure, to be fully informed as to the exact quantum of truth embodied in these statements, for their own protection in the lawful ownership, as well as in the undisturbed use, of such machines. It is, therefore, my wish to state a few facts, capable of easy verification by all whom they may concern, which will conclusively show that Mr. Gilliland's statements, above quoted, are simply without foundation.

The main feature of the so-called improved phonograph, and the "essential" of greatest value about the machine is the making of records of sounds by *cutting* or *engraving in wax*, instead of forming them by indenting a metal foil, which is the plan invented and employed by Mr. Edison until he adopted the method of cutting or engraving used for several years past in the graphophone. An examination of Mr. Edison's patents of 1878, which, according to Mr. Gilliland's statements, cover the cutting or engraving of records in wax, reveals the following:—

In his United States patents the only allusion to wax occurs in patent No. 200,521 of February 19th, 1878.

In British patent No. 1,644 of 1878, the same suggestion is found. The main specification filed October 22nd, 1878, contains the statements given below, which will be found on page 7 of that document.

"The material upon which the record is made may be of metal foil, such as tin, iron, copper, lead, zinc, cadmium, or a foil made of composition of metals. Paper or other materials may be used, the same being coated with paraffin or other hydrocarbons, waxes, gums, or lacs, and the sheet so prepared may itself be indented, or the material, say paper, may be made to pass through a bath of hot paraffin and thence between scrapers. Thin metal foil is now placed on the material, and the sheet passed through rollers, which give it a beautiful smooth surface. The indentation can now be made in the foil, and the paraffin or similar material, and the indenting point, does not become clogged with the paraffin in consequence of the intervening foil."

The utmost that can be made out of the above is, that Mr. Edison at that time conceived that he might substitute paper soaked in wax for the metal foil to receive the record formed by *indentation*, but, as the paraffin clogged the point of the style, he found that he could only use it as a backing for the metal foil.

The term *indenting*, as used by Mr. Edison throughout his patent specifications, clearly means the action of *embossing* or *shaping* the material without the removal of any part of it, as in forming a record in tin foil by pressing it into shape with the vibrating style. This method of forming records of sound vibrations is very defective, and the prospect of obtaining anything but a rough approximation to a true record by means of it, is beyond hope. The *cutting* or *engraving* process, in which the material is removed in the form of a shaving, is free from the defects of the indenting method, and greatly superior records are the result, as has been demonstrated for several years past by the graphophone, and now by the so-called improved phonograph, in which Mr. Edison has adopted this "essential," and made it his principle feature.

The indenting method is faulty in this method, viz., the formation of each indentation in a metal foil alters the shape of the one immediately preceding, as the material bends backward as well as forward for some distance around the point of the style. This defect is more noticeable in records of speech, as the distortion is greatest in the finer vibrations which lend quality to the sounds. The records of music being simpler and more regular, are less affected by the apparently unavoidable distortion due to the indenting method, and this accounts for the fact that such records are found to reproduce much more clearly and accurately than records of speech.

The quotation given above from British patent No. 1,644 includes everything relating to the use of wax I have been able to find in any patent or publication emanating from Mr. Edison, prior to the issue of the graphophone patents of May 4th, 1886, two of which Nos. 341,214 and 341,288, are directly infringed by Mr. Edison, in his so-called improved phonograph, as reference to the specifications and claims of these patents will show.

I do not undertake to quote all the twenty or more claims in our patents infringed by Mr. Edison, but only select a few of them for reference, to show how the "improved phonograph" has been perfected.

In patent No. 341,214, filed June 27th, 1885, and issued to Chichester A. Bell and myself, the following claims among others were allowed :—

Claim 1. "The method of forming a record of sounds by impressing sonorous vibrations upon a style, and thereby cutting in a solid body the record corresponding in form to the sound waves, in contradistinction to the formation of sound records by indenting a foil with a vibratory style, or cutting a strip by vibrating it against a revolving disc cutter."

Claim 3. "The vibratory cutting-style of a sound recorder."

Claim 4. "The cutting-style, in combination with a support permitting the same to be vibrated, and means for impressing sonorous vibrations thereon."

Claim 7. "A sound record consisting of a tablet or other solid body having its surface cut or engraved with narrow lines of irregular or varied form corresponding to sound waves."

Claim 9. "The method of forming a sound or speech record, which consists in engraving or cutting the same in wax or a wax-like composition."

Claim 12. "The sound or speech record cut or engraved in a wax-like composition, such as the compound of bee's-wax and paraffin."

Claim 24. "The combination, with a sound record formed in wax or a wax-like material, of a reproducer having a rubbing style for receiving sonorous vibrations from said record."

In patent No. 341,288, filed December 4th, 1885, and issued to me May 4th, 1886, the following claims will be found :—

Claim 1. "A recording tablet for a phonograph, consisting of a hollow cylinder provided with a wax or wax-like coating for receiving the sound record."

Claim 4. "A tubular self-sustaining tablet for recording sounds or sonorous vibrations."

Claim 5. "In a phonograph and in combination with a sound recorder or reproducer and operating mechanism for causing the said recorder or reproducer to trace a spiral line on the tablet, an elongated cylindrical tablet holder supported and journaled so that the tubular tablet can be placed on the same."

Claim 6. "The combination, with a tubular tablet of a tablet-holder for supporting and rotating the same."

Claim 37. "A recording-tablet consisting of a hollow cylinder provided with a wax or wax-like coating, and having a sound record cut in said coating."

Mr. Gilliland also states that "it has been asserted by some and believed by a great many that the work of improving the phonograph was undertaken and accomplished, not by Mr. Edison, but by other persons not connected with him." In view of what is given above, and the fact that machines under the name of graphophones using wax compositions for recording and reproducing speech and other sounds, have been in use for several years past; that a considerable number are in daily practical operation in business offices and other places at the present time, and that they are being eagerly taken as fast as they can be supplied, it is evident that the assertion quoted above from Mr. Gilliland, to which he takes exception—that the work of improving the phonograph was undertaken and accomplished by other persons not connected with Mr. Edison—is fully substantiated.

Mr. Gilliland also states that "on account of the rapid growth and extraordinary demand of the electric light business," &c., "the work of perfecting and preparing the phonograph for manufacture has necessarily been slow. This work, however, was not laid aside, but has been steadily kept up till the present date."

In the summer of 1885, while in New York City on business, I exhibited to several members of the Edison Speaking Phonograph Company a machine on which records of sounds were engraved and reproduced from cylinders of wax, in substantially the same manner as that used in the so-called improved phonograph of Mr. Edison. I was also shown at this time, by a prominent member of the Phonograph Company, a phonograph of large size, which, I understood, embodied Mr. Edison's latest ideas up to that time. It is very well described in Mr. Edison's own words in a characteristic interview published in the New York *World* of November 6th, and copied in the *Electrical World* of November 12th, 1887.

Mr. Edison's description is this : "It weighed about 100 lbs. ; it cost a mint of money to make ; no one but an expert could get anything intelligible back from it ; the record made by the little steel point upon a sheet of tin-foil lasted only a few times after it had been put through the phonograph. I myself doubted whether I should ever see a perfect phonograph ready to record any kind of ordinary speech, and to give it out again intelligibly. But I was perfectly sure that if we did not accomplish this the next generation would. And I dropped the phonograph and went to work upon the electric light, certain that I had sown seed which would come to something." This, together with another statement of Mr. Edison, contained in the same interview from which the above is quoted, that he only resumed work on the phonograph eight months before, and also with the fact that members of the Phonograph Company informed me in 1885 that they were trying to induce him to work on it, seems hardly consistent with Mr. Gilliland's assertion that "this work was not laid aside, but has been steadily kept up till the present time."

In view of the above it is hardly necessary to adduce other facts to contradict Mr. Gilliland's statements. It is well known, however, that the Edison Speaking Phonograph Company was formed upon the expectations created by this apparatus, with ample capital to work and introduce it commercially, which company is in existence to-day, and has been supplying the very limited demand that has existed in the intervening years for the Edison phonograph. This tells the whole story of the development from 1878 to 1887, during which time the primitive apparatus of the former year was never materially improved.

The graphophone shown to Mr. Edison's associates in 1885 made a perfect record by engraving or cutting the same on the surface of a cylinder composed of a mixture of beeswax and paraffin, from which the reproduction was distinct and intelligible, and could be repeated indefinitely ; in a word, it accomplished everything claimed for the so-called improved phonograph of Mr. Edison. This instrument, operated by hand, formed the subject matter of Patent No. 341,288 issued to me May 4th, 1886, and was illustrated and described in an article in *Harper's Weekly* of July 17th, 1886.

Electric, water, spring and weight motors have been devised to turn the machine, but they were all found to possess serious objections when put to practical use. The battery of the electric motor proved a source of great annoyance, to say nothing of the cost of maintaining it, which is considerable, and it is sure to fail just at the time it is most needed. Electricians who have tried to obtain power enough from a primary battery to run a machine of this description for any length of time will appreciate the difficulties in the way.

Water motors worked well, and are particularly adapted to the purpose on account of the noiseless character of their operation, but the source of water supply in this case is the difficulty. For driving a machine always occupying a fixed place, convenient to water pipes, this form of motor is the best, with the possible exception of an electric motor connected with an electric light or power station. Spring and weight motors are too costly ; necessitate gearing difficult to make so as to run quietly enough ; are hard to regulate with the nicety required, and must be wound up frequently ; all of which are serious objections. The form of motor I have found to best answer the requirements for general use is the ordinary treadle. It does not run down, requires only the simplest mechanism, does not get out of order, is available everywhere, and can be made for a small fraction of what other motors cost. The power necessary to run a graphophone amounts to only a fraction of that required for a sewing machine, and the treadle can be worked for hours without the least fatigue. I have, therefore, fitted the graphophones with treadle motors, and they have been found to answer very satisfactorily.

After selecting the kind of motor best suited to the machine, it became necessary to devise a governor suitable to use with it, for it is necessary, especially in recording and reproducing music, to have an absolutely uniform speed, and that all machines should be regulated to run at exactly the same velocity, so that records made on one machine can be reproduced properly on any other. This I have satisfactorily accomplished, and in the latter part of 1886 I devised the following arrangement. This consists of the graphophone instrument previously mentioned mounted on an ordinary stand similar in appearance to a sewing machine table. The belt from the treadle pulley below passes up through the table to the governor or regulator in the back part of the case, from which a second belt drives the graphophone. The arrangements are such that about 60 strokes of the foot per minute are sufficient to drive the machine at full speed, and any increase in the rapidity of the motion of the foot or irregularity in its action has no effect upon the speed of the instrument, which always turns at the velocity to which it is adjusted.

The graphophone is arranged for recording a conversation between two persons, the speaking tube resting on the table being used by one, the operator of the machine for instance, and the other tube hanging from the support at the left-hand end of the table is used by the second person. Both terminate in a single tube which is connected with the recorder of the machine. The reproducer and its hearing tube, and also a blank record cylinder, rest upon the cover at the back.

Machines of this design have been in operation in Washington for at least 18 months, and they have also been exhibited successfully in other places in different parts of the country. About the first of May, 1887, one of these machines was taken to New York City by myself and a party of gentlemen, connected with the American Graphophone Company, for the express purpose of showing it to Mr. Edison and his associates of the Edison Speaking Phonograph Company. Upon our arrival in New York, however, we found Mr. Edison ill at his home in New Jersey, and so did not have the pleasure of showing him the graphophone; but several of his associates of the Phonograph Company inspected and tried the machine, and I think were pleased with its performance. As Mr. Edison resumed work on the phonograph about this time, and afterwards adopted the most important "essentials" of this machine, I conclude that he also was fairly well satisfied with its performance, as reported to him by his associates.

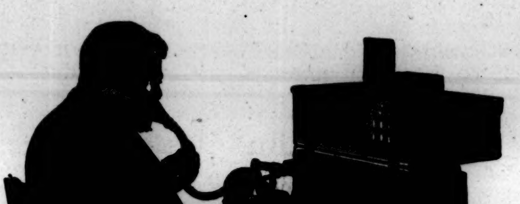


FIG. 1.

In the spring of 1887 I designed the form of graphophone shown in figs. 1 and 2, for the purpose of getting the apparatus into a cheaper and more convenient shape to manufacture, and also to increase its efficiency and ease of manipulation. This machine is the one in practical use at the present time, and being manufactured for sale by the American Graphophone Company, which company controls the invention for the United States and Canada.

Fig. 1 shows the machine in condition for making a record, and a person in the act of dictating to the instrument. Instead of a single speaking tube and mouthpiece, as shown in the cut, a double arrangement is used when it is desired to record a conversation between two persons. This is found very convenient for taking depositions and in similar work.

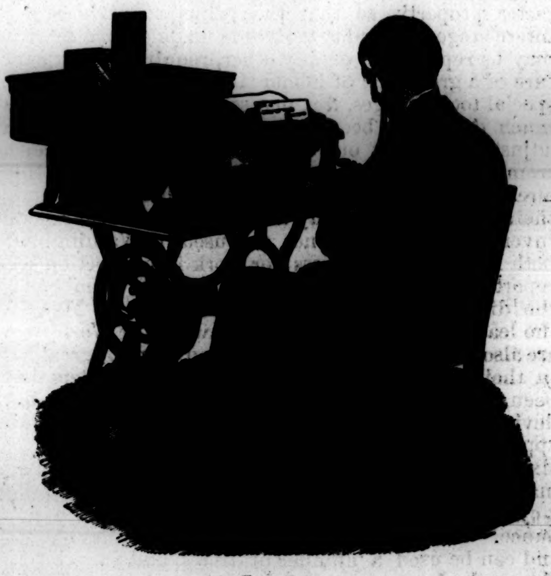


FIG. 2.

Fig. 2 shows the machine arranged for reproducing the records and making a type-writer copy. By pressing one of the small keys shown on the right of the graphophone, the reproduction of what is recorded on the wax cylinder commences, and when as many words as is desired are reproduced, a slight pressure on the second key stops the cylinder while the motion of the foot and regulator continue, and the words reproduced are printed by the type-writer. The first key is then pressed again, and a few more words of the record reproduced, which are in turn printed by the type-writer, and so on throughout the record. The capacity of a wax cylinder 6 inches long and 1¼ inches in diameter when dictated to at the rate of 150 words per minute is about 700 words, but if the cylinder is given the surface velocity used by Mr. Edison in the so-called improved phonograph, the capacity would be about 1,700 words. I have found it advantageous, however, to use a higher surface speed, as the reproduced sounds are thus made louder and clearer. The groove cut in the wax by the recording style is only $\frac{3}{1000}$ths of an inch wide, and less than this in depth, and 161 grooves to the inch are cut on the cylinder. The total length of the record on a six-inch cylinder will therefore be about 250 feet. Cylinders two, four and six inches long are used. The operation of changing them does not occupy five seconds, and six-inch cylinders will be sold for about three cents each, and the shorter ones in proportion.

The graphophone, as manufactured, can be converted from a single to a double machine by simply applying the extra parts for holding the second cylinder, the key connection, and an extra recorder. A few minutes only is required to make the change. Each cylinder has a separate recorder, the two recorders being connected to one speaking tube, and two records are made at the same time with no more effort than is required to produce one. This will be found useful for correspondence, one record being sent to the correspondent and the other retained for the copy. There are other uses to which this feature can be applied with advantage, which will readily suggest themselves to the users of the machine.

Owing to the limited facilities at my command, the work of developing the graphophone and fitting it for practical every-day use has necessarily been slow. I have not enjoyed the benefits derived from wealth and a laboratory with a hundred or more assistants; nor have I been fortunate enough to have a number of factories at my disposal in which to manufacture machines.

The commercial graphophone was completed last summer and put into the hands of the manufacturers early last fall. To manufacture apparatus of this character properly, so that the principal parts will be interchangeable, and that records made on one machine may be reproduced on any other, requires the expenditure of a great deal of labour in the preparation of the special tools, gauges, &c., necessary to do the work, and much delay has been the result. The machines are adjusted and put out as rapidly as they are received from the manufacturers, and the success of those already in practical every-day use has demonstrated their entire practicability and value as a labour-saving invention. Graphophones are used in Washington in both Houses of Congress for work in connection with reporting the proceedings, and also by members for the dictation of their correspondence, &c. Many of the leading stenographers and lawyers of Washington are also using the machines, and find them of great help in their work. Thousands of record cylinders have been issued to supply these machines, and I have devised and had constructed special machines and appliances to make them cheaply and accurately. A six-inch cylinder weighs less than half an ounce, and mailing boxes have been devised weighing (including a cylinder with 700 words recorded upon it) about one ounce. These boxes will be sold for a smaller amount, and can be used a number of times, and pass through the mails for two cents. at letter postage. Arrangements are in progress for manufacturing graphophones and cylinders on a large scale, and in a short time they will be turned out in sufficient quantities to supply the very active demand.

The Telegraph and Life Saving.—Sir G. Baden-Powell asked the First Lord of the Treasury on Monday whether with a view to the better prevention of loss of life and property in cases of shipwreck, for the general advantage of the shipping and fishing industries, and for the more effectual defence of these realms in time of war, Her Majesty's Government would during the recess take into consideration the provision of a complete system of telegraphic communication between the postal telegraphs and all coastguard, lighthouse, lifeboat and life-saving stations situated on the coast of the United Kingdom. Mr. W. H. Smith: With reference to the better prevention of loss of life and property at sea, I can only remind my hon. friend of the answer he received on the 16th of April last from my right hon. friend the President of the Board of Trade. In that answer it was stated that certain experiments must be continued for another 18 months, and, as that period has still many months to run, I am unable to give any further information on the subject. So far as regards the safety of this country, my hon. friend may rest assured that any measures which in the judgment of the Government are necessary for security will not be neglected by Her Majesty's Government.

Telegraphic Tenders Wanted.—Tenders are required for connecting telegraphic communication, &c., between the several baths, &c., the property of the Corporation of Bath, which is more particularly described in a specification which can be seen on application to Mr. Yates, Royal Baths, Bath. Tenders, properly endorsed, to be sent to the Chairman of the Hot Mineral Baths Committee by 9th inst.

THE COPENHAGEN EXHIBITION.

MESSRS. L. M. ERICSSON & Co., of Stockholm, exhibit, amongst a number of meteorological instruments, a self-recording wind gauge, which registers electrically, every 10th minute, the velocity and direction of the wind. Further, we notice an automatic switch for small telephone exchanges, and a set of telephone apparatus for travelling purposes. The different types of telephones and Morse instruments employed by the Royal Swedish field telegraph, and some instruments as used by the Swedish railways are also shown. Two systems of fire telegraphs for large and small towns respectively, and a number of ordinary resistance boxes, astatic and tangent galvanometers, a metre bridge, and some sensitive galvanoscopes are also well worth inspecting. The most interesting of Messrs. Ericsson's exhibition are, however, the microphone transmitters of this firm's own design. There are two microphone transmitters exhibited, an old and a new form. Ericsson's old microphone is very much in use throughout Sweden; it works by a single contact, and has the diaphragm placed horizontally. The sound waves are concentrated by means of a kind of curved funnel, and the contact is made by a pin, the top of which is provided with a piece of platinum, while its other end terminates in a little carbon plug. The pin is placed in such a manner between a carbon plate, fixed to the diaphragm and a platinum head resting on a spiral spring, that the contact at both ends is formed between carbon and platinum. One Leclanché cell works through the primary of the induction coil, the spiral spring, the pin, and the contacts; and all the movements of the pin being vertical so that no friction is possible, this microphone gives a very clear articulation. Ericsson's new microphone has especially found favour in Denmark, Norway, and some parts of Russia. It consists of six small carbon rods, which are loosely fastened under the diaphragm and made to touch six points of a little carbon bar fixed to the centre of the diaphragm. On account of the very delicate suspension of the carbon rods, this microphone is very susceptible to sound vibrations, and the articulation produced is very clear. It possesses more penetrating power than the old microphone and works remarkably well on 50 to 60 miles of ordinary landline with several exchanges in circuit, but does not appear to be superior to Blake's transmitter on circuits composed of cables or subterranean lines. The Ericsson's microphone is exclusively used by the "Allmânna" Telephone Company, of Stockholm, with its 5,500 subscribers.

It may be of interest to mention here that in no city in Europe has telephone enterprise met with such enormous success as in Stockholm, and a comparison with other large towns will show this in a most striking manner. For every 1,000 inhabitants Stockholm has 25 telephone subscribers, Rome has 6·5, Copenhagen 5, Amsterdam 4, Berlin 3·5, Brussels 2·1, Paris 1·5, Petersburg 1·3, London 1 and Vienna 0·8.

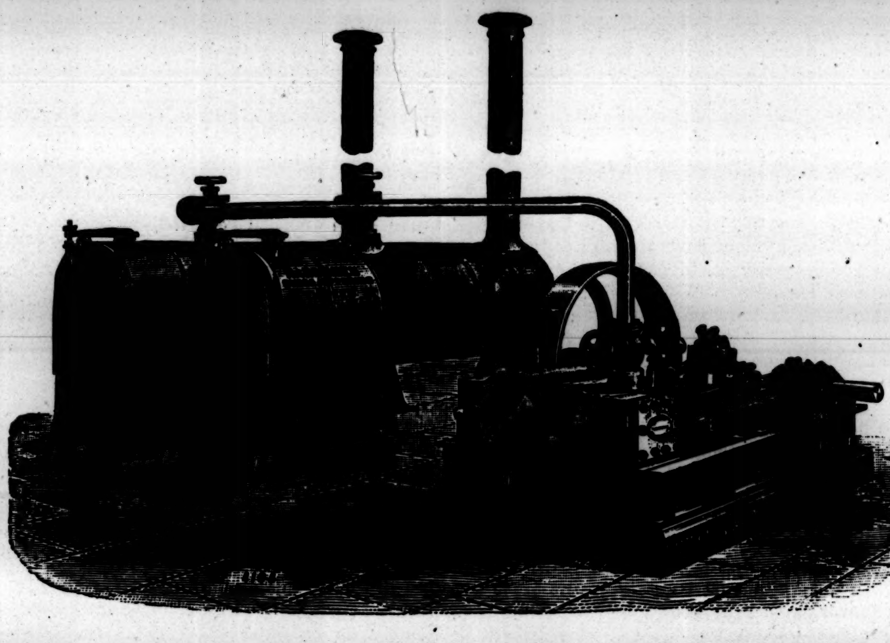
The prizes have now been distributed in accordance with the decision of the jury, and it may interest our readers that a first class medal has been awarded to the Great Northern Telegraph Company, of Copenhagen, to Messrs. L. M. Ericsson & Co., of Stockholm, and to Mr. P. la Cour.

Who was Responsible?—The story which the *Journal of Gas Lighting* relates respecting the breakdown of the electric light installation in a Hydropathic establishment in Matlock, on the inaugural evening is a sad one. Many persons were present to witness the initial run of the machinery, a band had been provided to enliven the proceedings with strains of harmonious melody, and at 8 o'clock the driver was requested to do his best. How he carried out his instructions may best be learned from the statement that the two pullies on the countershaft and the dynamo were broken. We are not aware who had the fitting up of the Matlock establishment.

RANSOMES, SIMS AND JEFFERIES.

THIS firm exhibited at the recent Royal Agricultural Society's show at Nottingham, amongst several others, a 20 H.P. compound undertype engine and boiler, the advantages of which the makers desire should be better known. The engine is a fine specimen of workmanship and finish, and where economy of fuel is a consideration would be found exceedingly valuable. The cylinder and working parts are mounted on a strong wrought iron girder frame; the boiler is placed over the engine on the same frame, resting at the smoke box end on the cylinder, the frame being extended beyond the crank shaft to form an ash pit for the fire box.

These engines are specially adapted for export, not only on account of the ease with which they are fixed, but as the boiler can be detached from the engine and the girder frame taken to pieces, the weight of the packages may be considerably reduced so as to facilitate transport, a matter of the utmost importance in many countries. The engine occupies very little space and requires no expensive foundations.



Messrs. Ransomes also supply these compound engines with separate or detached boiler, as shown by our illustration, two boilers often being found more convenient than one larger boiler on account of the greater facility in transport already referred to. These boilers are made of mild steel plates throughout, and the fire boxes, when desired, may be of extra large dimensions for burning every description of inferior fuel.

ELECTRIC RAILWAYS.

THE SOLUTION OF MUNICIPAL RAPID TRANSIT.

THE admirable paper bearing the above title, which was recently read before the American Institute of Electrical Engineers, by Mr. Frank J. Sprague, deserves the study of everyone interested, directly or indirectly, in matters appertaining to means of transport. Capitalists, engineers and vestrymen, no less than tramway directors, should be made aware of the progress which is being brought about by persevering pioneers of electric locomotion in all parts of the world, and practical lectures, teeming with accomplished facts, like the one under consideration, ought to cause an awakening in the minds of those whose business it is to assist in the advancement of public comfort, convenience, safety and economy. Excepting readers of electrical journals, few people in Europe are aware that the United States possess 35 electric tramways which are in daily operation and an equal number in course of construction. Various systems are represented in this number, but the largest and probably the most complete of the kind is the line at Richmond, Va., which we have already commented upon in a leader of our issue dated June 15th last.

Mr. Sprague's paper is a lengthy one; at the commencement he treats of the advantages of electric street railways and the principles involved in their construction; regarding these his views coincide very much with those of Mr. Alex. Siemens, Dr. Hopkinson, Mr. A. Reckenzaun and others, which are known to our readers. The last part of this valuable communication refers to the gain which the elevated railroads and the projected underground railway of New York would experience by using electricity in preference to other modes of energy for propelling trains or cars; but the portion of Mr. Sprague's paper which strikes us most is the description of the Richmond line and the detailed account of the daily working expenses. If it has been a question of £ s. d. which retarded enterprise on our side of the Atlantic, the figures which follow may have a beneficial effect in inspiring confidence in this new and apparently most lucrative industry.

The author says :—"Some idea of the character of the road may be gathered from the following :—The total trackage is about 12 miles. It runs a very irregular course and reaches the principal parts of the city. About 9 miles of street are covered. The central section is a double track for a distance of something over two miles, a part being laid on paved streets, and the balance on macadam or unpaved streets; all the extension and branch lines are on unpaved streets, many of them in clay soil, which, in wet weather, covers the tracks, and where it would be an impossibility to operate horses without paving. The double track section partly encircles the old State Capitol, and presents difficulties rarely equalled elsewhere. This part of the line, in a distance of less than 1,000 feet, has on both east and west-bound tracks four curves, the inner rails of the west-bound track being of about 27, 30, 40 and 30 feet radius. The power necessary to run these sharp curves is much increased by the fact that grades are encountered on the curves as high as 8 per cent., and the lay of the street has required some of the outer rails to be some inches below the inner one. Running eastward from the Capitol, the road descends to a low valley through a series of grades, varying from

3 to 10 per cent., and then ascends a series of sharp grades and curves in a new district, to one of the car houses.

"The narrow streets, their hilly character, and the lack of paving, especially in the new districts, has made the road one of exceptional difficulty to operate. There are no less than 29 curves, requiring bent rails, the majority being of sharp radius, five being less than 30 feet. There are also several sweeps or curves of large radius, several turnouts and cross-overs. The grades are the maximum ever ascended in practice by a self-propelled car depending on track adhesion alone, and many of these grades are very long. Going east there is one section of almost continual ascent for about 5,600 feet, with grades varying from 3 to 7 per cent., and going west there is a stretch of 1,900 feet, with grades varying from 3 to 10 per cent.

"The difficulties we have met are many. One of the most annoying at first experienced was that the cars frequently jumped the tracks. A large portion of the track was, as has been stated, laid in macadam and dirt streets, the latter being chiefly in new districts and in a soil of which the chief component was red or yellow clay, and, although the curves were of a sharp radius, only one guard rail was used, and they were not bound in by paving. The winter months brought frequent and heavy rains. The tracks were found to be settling out of sight in mud, and especially at the curves they were spreading. The cars being large and heavy, with a 4 feet 8½ inches gauge and a 6 feet wheel base, helped to make the curves spread by the tangential pressure of the forward wheels on the outer rails. Mud and stones would get into the grooves, and the cars having a tendency to go ahead, instead of being pulled around by the head as with horses, would climb the track, and before an inexperienced man could check them, the wheels were down 5 inches in the mud along the stringer pieces and the track brakes hard and fast against the tracks. Sometimes it was lifting, sometimes prying, and sometimes a heavy, hard pull on the part of the motors to get them back again. Experience, however, is a great teacher, and among other things which has been taught is this: that money will be saved by a good track construction and the observance of a few practical points. All curves should be bound in and paved, and this has been done in Richmond.

"The power house is situated two blocks away from the nearest point of the line, and is almost equi-distant from its extremities. As a distributing point it is, therefore, both theoretically and practically, a central station. In the construction no expense has been spared, and the performance of the station has justified it. The battery consists of three cylindrical return tubular boilers of the latest pattern, mounted on a Jarvis patent furnace, their capacity being 125 H.P. each. The water is taken from the city mains or from a well. All feed water connections are of brass pipe. From the pumps the water passes first through the feed-water heater, where it is heated from 150 to 200° F. From there it goes to the filter. The draft in the furnaces is regulated by an automatic steam damper regulator, which, with anything like regular firing, keeps a pressure within two pounds of that for which the regulator is set.

"The boilers all feed into one main feed steam pipe, which in turn leads to a separator, a large iron cylinder into which the steam passes, the water falling to the bottom and the dry steam being carried off at the top. All live steam pipes in the boiler room are covered with magnesia.

"The present battery occupies less than half the available space in the boiler room, so that four more boilers can easily be put up when it becomes necessary to enlarge the plant. Two more have just been added. An important feature of these boilers, which are the source of power of the whole system, should not be overlooked, that is, the quality of coal burned. Where a very perfect combustion is obtained, a grade of coal can be used which would be impracticable in an ordinary furnace; the mixture at present being used is two parts screenings to one part bituminous, costing from $1.75 to $2 per ton delivered. As the station is only 300 feet distant from the depôts of three railroads, coal can be obtained almost at the door. From the boiler room, both the steam and exhaust pipes run in an underground, mineral wool-packed trench to the engine-room.

"The engines, of which there are at present three, are of the Armington and Sims high-speed type, and develop when running at full load 125 horse-power each at 250 revolutions.

"Each engine drives two special Edison dynamos of 44,000 watts capacity each, wound for 500 volts maximum pressure. The dynamos feed into copper 'bus' bars, supported on the walls by porcelain insulators.

"Each machine has its independent ampèremeter, and in addition there is a general ampèremeter at the end of the positive 'bus' bar. From this bar the current passes to four snap switches, each switch being connected through a three-plug safety switch block, to one of the feeders supplying current to the main line wire. These four-feeder wires tap into the line wire at different points, thus maintaining the pressure approximately equal all along the line. At the ends of one of the feeders in the central station, pressure indicators are to be attached which will indicate the voltage at the junction of one of these feeders with the main current wire, and this will serve as a guide.

"The electric circuit consists of two parts—the overhead and the ground circuit, each being of compound character. Along the curb stones at distances of 125 feet are 30-feet poles, inserted into the ground a distance of 5 feet. Great difficulty was experienced at first on account of the clayey character of the soil, and it became necessary at the corners to put in very heavy poles, which were imbedded in concrete and stones to prevent settling out of place after heavy rains. These poles carry the main circuit which extends throughout the entire length of the roads, and is a copper wire $\frac{3}{16}$ths of an inch in diameter; this is called the main conductor, for on it depends the operation of the road in case of accidents or repairs to the contact wire.

"The arrangement of main and working conductor are as already set forth.

"This main conductor is, as stated, supplied at widely separated points by feeders, which come from the main supply at the central station. Without the use of these feeders, which can also be reinforced if necessary, the size and cost of the overhead conductors would be very largely increased. The curves are formed of a series of short chords, which approximate the central line of curvature.

"The current is taken from this working conductor by a light structure on top of the car. This consists of a low skeleton framework which carries an adjustable swivelling trunnion, having at its upper end a jaw in which is suspended a counter-balanced trolley pole, having at its extension a grooved wheel held by a spring against, and making running flexible contact with, the under side of the working conductor. The flexibility of this arrangement is very great, it being able to follow with perfect facility variations of the trolley wire two or three feet in either horizontal or vertical direction, at any speed, and around any curve. What is all important, it relieves the line of strain instead of adding to it. When getting at the end of the track this trolley trunnion is swung around so as to trend in a proper direction abaft the centre of the car. If off the line it can be replaced from the car quickly and easily in the darkest night. From the trolley the current passes through a protected wire to the lightning arrester and thence to two switches, one at each end of the car, whence after whatever commutation is necessary, it goes to the motor circuits, and thence to the wheel frame.

"The return circuit is through the track, and thence by both metallic and ground circuits to the station. Each section of rail is joined to a copper ground wire, which runs throughout the length of the road underneath or alongside the stringer pieces, which is to prevent appreciable differences of potential existing between the rails; as a further precaution, at intervals of 500 feet, this ground wire is connected to an earth plate, and at seven points widely distributed, these ground plates are supplemented by heavy iron pipes sunk into iron ore, or 12-inch water wells, about 25 feet deep. The ground wire is connected to the station, and there is also a main ground connection made there in a 30-foot well through a large sink plate, and another to the entire waterworks system. Some modifications of the overhead system are now being made which will make it impossible for any accident to one section of the line to disable the remainder; will enable the different sections to be operated independently; and, in case of a fire which may necessitate the blocking or temporary disabling of one part of the line, will allow this section of the line to be cut out of action either automatically or at will.

"Each car is fitted with a duplicate and very powerful motor equipment. This is carried entirely beneath the car body, is very compact, out of sight, and necessitates no radical change in the construction of the car. The body had to be stiffened a little and 3-inch steel axles put in.

"The motors, although in one sense independent, are connected with duplicate switches at either end of the car, which affords simultaneous control of both machines. These motors, which are of normal capacity of 7½ horse-power each, can for a short time work up to 30 horse-power, and are capable of producing a tractive effort of over 3,000 lbs. at 50 per cent. efficiency.

"The machines are controlled by a single movement switch which effects the various commutations and reversals. They run with fixed brushes in both directions and under all loads. They are run without any covering, and I have no doubt of having street car motors in such condition soon, that the cars will be run over a pit, and the machines washed down with a hose.

"Sixteen-foot closed cars carrying picked loads of 55 to 60 passengers, and having a total weight of 15,000 lbs., are operated on the 10 per cent. grade, often with a slippery and slimy rail, and on 27-foot curves, without the use of sand or extra help.

"These same grades and curves have been ascended without sand after one of the worst sleet storms which has visited this section for years. Various tests under the most unfavourable conditions have been made, cars often being required to cut their way through clay, snow and ice when the tracks were out of sight. No severer test could have been made, and the power and tractive effort developed have exceeded the most sanguine expectations.

"Cars have often been stopped and started on the heaviest grades, and in the sharpest curves. One motor has propelled two cars around sharp curves and up six per cent. grades. One car has pushed another of greater weight around the sharpest curves and up seven and eight per cent. grades both straight and combined.

"I have no hesitation in saying that with a clean track, and with proper gearing, these cars could mount a 15 per cent. grade, depending on adhesion alone.

"The figures which follow, being based upon an actual service increasing from 8 to 30 cars, and extending over a period of four months, under the most trying circumstances, and at the most critical and care-requiring period of the enterprise's existence, will give street railway men the most careful and liberal estimate of every possible expense attending the operation of the road which is in any way dependent upon its electrical features. The operating expenses are given under two heads: first, the central station operating expenses, and second, the road operating expenses, the two constituting the total cost of motive power. These are given in detail, and they will probably be found to cover every expense, although in some small ways the distribution of these expenses may be found to be changed by several months longer running. The fuel and other incidental expenses of the station are from the engineers' record, and checked by the readings of the electrical instruments.

"For 30 cars running on a double track the central station expenses are about as follows:—

$52\frac{41}{100}$ cwt. coal, at 10 cents	$5.84	
$113\frac{70}{100}$ cwt. screenings, at 7 cents ...	7.96	
Five pints cylinder oil, at 75 cents per gallon	.47	
Five pints dynamo oil, at 30 cents per gallon	.18	
Three pounds waste, at 10 cents	.30	
Water at current rates	3.00	
Fuel, &c.		$17.75
One day engineer	$3.00	
One night engineer	2.25	
Four firemen	6.00	
One cleaner	1.50	
Two dynamo men	3.50	
One electrician	4.00	
Labour...		$20.25
Lighting		.50
Depreciation and repairs on dynamos, 3 per cent.		1.50
Depreciation and repairs on engine and boilers, 10 per cent.		4.38
Total central station expenses ...		$44.38

or $1.48 per car making 80 miles.

"[The central station being operated for 24 hours for lighting and power purposes, the lighting company has now assumed charge and rents the power to the cars at $1.60 per day.]

"In estimating the road expenses more than liberal allowance is made, but in a new enterprise it is safe to err on this side rather than attempt to claim for a system advantages which will not in practice be borne out. The expenses are then as follows:—

Oil, grease and waste	$4.50	
Brushes	3.00	
Trolleys	2.00	
Material		$9.50
Three mechanics and one helper for thoroughly overhauling motors once a week, making repairs, adjusting brakes, &c.	$7.90	
Four inspectors, two day and two night, for oiling machines and looking after brushes	7.50	
Two night inspectors to thoroughly inspect motors after cars are laid up and see that all bolts, nuts and connections are tight and that everything is in good working order for the morning run ...	4.00	
One winder and helper for making any repairs which may be necessary and any testing which is required	3.50	
Two linemen	5.00	
Labour		$27.90
Depreciation on car work at 15 per cent.	$18.00	
Depreciation on line work at 10 per cent.	4.00	
Depreciation		$22.00
Total road operating expenses ...		$59.40

Or $1.98 per car making 80 miles.

"The total motive power expenses, both in the central station and out on the road, would not then exceed $3.46 per car making 80 miles, or 4.32 cents per car mile, and this includes everything except the executive and salary expenses, taxes and insurance, and is less than 40 per cent. of the cost of operation by horses with the same number of cars, and under the same conditions.

"But the showing is even better than this, for another fact is to be noticed, and it is an important one from an economical point of view. For example, 20 cars on duty for about 18 hours make a mileage of from 1,500 to 1,800 per day, and if it were not for the fact that the schedule requires them to operate part of the time on a single track with insufficient turn outs, they could make 1,800 or 1,900 steadily. This, notwithstanding the fact that the speed is limited by municipal regulations. Many of the cars often run 90 to 100 miles. The same mileage and intervals made by 20 electric cars could not, under the circumstances, be made by anything less than 25 horse cars of the same size, and the electric cars probably carry in the aggregate just as many passengers. It follows that to get the same service with horses not only would the number of cars have to be increased, but likewise the number of horses, conductors and drivers. The same mileage performed by horses without these cars and grades, would require a stable equipment of not less than 300 horses.

"With the mileage which is now made, there is an actual saving of about $125 per day in the motive power expenses as against operation by horses. It is hardly necessary to point out that this would pay a good interest on a pretty large investment. The capacity of the road to economically carry passengers has been made so apparent that the old city railway, which was operated by mules and has about 13 miles of track and 50 cars, has been bought up and is to be equipped with motors operated from the same central station. A third line will probably be added, and in the near future every street car, to the number of 100, in Richmond and Manchester will be electrically operated from one station."

Mr. Sprague mentions in one part of the paper that "when we first undertook to equip this road in the face of these difficulties, there was the additional discouragement of the ridicule of a great many prominent street railway men and car constructors as well as electricians." We must congratulate the company on the eminently successful termination of their difficult task, and we would advise all our friends to take a leaf out of the book of our plucky and enterprising cousins across the Atlantic.

PRACTICAL NOTES CONCERNING THE CONSTRUCTION, USE AND MANAGEMENT OF STORAGE BATTERIES.

By A. RECKENZAUN.

(Continued from page 37.)

Experiments with Storage Battery Cars.

CAR No 3, with a constant load of 7·4 tons, was next subjected to different tests by varying the number of cells actually in use; the cells were simply cut out of circuit, but they were kept on board so as not to diminish the weight carried. The track in the yard was in good condition, and the car was stopped and started at the end of each round trip of 1,005 feet. Four points of the switch were used, and for each point, or position, which represented a distinct combination in the motor circuits, the speed of the car was ascertained. Thus, with 100 cells in use, and with the switch handle at the first notch when the motor circuit gave the highest resistance, since all the coils were placed in series, it took 2 minutes and 30 seconds to go once round from the instant of starting to a dead stop with the brake on; this gave an average speed at the rate of 4·56 miles an hour. With the switch handle at the second point the trip was made in 1 minute 50 seconds, equal to a rate of 6·218 miles an hour. At the third combination 1 minute 15 seconds, giving 9·12 miles; and with the fourth combination 1 minute and 5 seconds, showing a rate of 10·52 miles per hour, including time taken in starting and stopping.

With 90 cells in use the time taken on each round trip was as follows: first point on switch 2 minutes 53 seconds; second point, 1 minute 53 seconds; third point, 1 minute 20 seconds, and with the fourth combination 1 minute 10 seconds.

Then 80 cells were coupled up in series; with the switch handle at the first notch the car went all right until it nearly reached the summit of the hill where the grade is 5·5 per cent. for a short distance, and then it came to a standstill; the power with all the motor coils in series and the reduced E.M.F. was not sufficient to bring the load over this grade. The second combination gave ample power and the trip was made in 2 minutes 4 seconds; the third point 1 minute 35 seconds, and the fourth 1 minute 20 seconds.

With only 60 cells in use, and the load of 7·4 tons, we started on the third notch, which carried the car over the track easily in 1 minute 57 seconds; and the fourth notch, representing a powerful combination, completed the journey in 1 minute 20 seconds.

These tests were valuable in so far as they gave the exact speed for each position of the switch handle, and especially the results with different numbers of storage batteries. For ordinary speeds, and grades of the description given on page 7, we found that 100 cells showed the most economical results with all the variations of speed and power.

Effect of Snow on the Track.

In anticipation of severe snowstorms, which occur so frequently in many parts of the United States, car No. 1 was fitted with a snow plough and wire brushes. This plough was ingeniously constructed; the shears were fixed to a balanced frame underneath the front platform of the car. Very little pressure on a stud which could be moved up and down by the foot of the driver, brought the shears into contact with the rails. Immediately behind the plough shears, and just ahead of the front wheels of the car, were brushes (made of stiff steel wires), and these were kept scraping on the rails by means of weights. The plough served the purpose of removing the bulk of the snow, and the brushes swept the rails and grooves clean in front of the wheel flanges. One day it snowed very hard, and when the rails were covered to about one-quarter of an inch we took this car out, using merely the wire brushes and a little sand on the steepest grade. The first round trip over this snowed up ground took 2 minutes and 8 seconds, but it cleared the track completely; the average current used was 50 ampères. Twenty trips were then made in succession, taking on an average 1 minute and 45 seconds, with a mean current of 30 ampères, snow falling hard all the time.

Then we allowed the snow to accumulate for four hours until it was about 2 inches deep; on starting the car, and during the first journey, the plough, the brushes, and sand had to be called into requisition. The current used averaged 80 ampères, and the time 2 minutes and 20 seconds; but each succeeding trip took less time and less current, until it reached its normal value. This shows that with proper appliances, and with cars rapidly succeeding each other, the track can be kept clear; but the accumulation of much snow in the first instance occasions a fearful demand of energy, and without plough and brushes the snow is compressed by the wheels, and renders locomotion almost impossible.

On one occasion snow was shovelled upon the track 4 inches deep and beaten down; the car started with great difficulty, because the shears and brushes were practically buried; but with a skilful manipulation on the part of the driver, by going forwards and backwards a few inches at the start, and using sand from the automatic sand-box, provided for the purpose, the vehicle cleared itself and made its journey, slowly at first, gradually a little faster, until at last a tolerably clean rail was obtained by the traffic over it.

Without plough and brushes it is not only very difficult to make any progress through snow, no matter what power there be at disposal, but the car wheels are very apt to leave the track and ride over the compressed snow, which gets as hard as ice, when it can only be removed by the application of crowbars and scrapers, or a free use of salt.

A properly constructed ammeter will give more faithful indications than a dynamometer, and the minutest variations in tractive force can thereby be ascertained in an instant, since there is neither momentum nor friction of measuring instruments to be accounted for. By careful observations we were enabled to record the effect of various comparatively small obstacles upon the rails, and we have found that dry dust and snow virtually doubled and trebled the energy which was found necessary on clean or moist rails.

A simple calculation will show that there is no worse policy than economy in looking after the condition of tracks. The slightest attention to this requirement will show a very material saving of power. Tramway engineers know this to some extent, but they have evidently not found out the exact numerical value of cleanliness, otherwise they would be more particular. An electric car will run twice the distance with the same amount of energy on a clean wet rail that it will on a dry one with grooves full of dust. With storage battery cars, careful attention to the road will especially count, since the life of the cells can be more than doubled with half the rate of discharge. Considering the vital importance of these facts, we need not apologise for the rather lengthy treatment of this branch of our subject. By reducing the tractive resistance we can diminish the weight of the battery, or increase its durability, the cost of cleaning the rails will be more than recouped by the smaller depreciation of the plates, and the saving of propelling power may be taken as a clear gain.

(*To be continued.*)

LIGHTNING.

By S. A. VARLEY.

(*Continued from page* 89.)

I FEEL the title that heads this article must seem somewhat of a misnomer, and as a matter of fact, I wanted to alter it when it was too late to do so; but it was the observation of the action of a lightning discharge on a telegraph circuit in 1856 which directed my attention to magnetic inertia, the source, as I believe, of all the so-called self-inductive phenomena, and it was the late lectures on the protection of buildings from lightning, by Professor Lodge, that led to the writing of the article, and hence the title which was chosen.

By directing attention, as I have now done, to the important part which the inertia of magnetism plays in dynamos, I think I may claim to have made a step in advance, for I consider I have linked to a certain degree the mechanical force developed in the steam engine with the internal forces in the mass of matter composing the machine, and this, as far as I know, has hitherto never been attempted to be done; further, I think I have thrown light on the *modus operandi* of the transmission of energy by dynamo machines.

In a previous portion of this article, I have likened the development of energy in a dynamo to a bombardment of a mass of matter which produces heat in place of motion of the mass; but what I wanted to convey would, I think, be more popularly explained by a further illustration. Assume we have a large mass of matter suspended in the atmosphere, the attraction of the earth being balanced and neutralised. If force be applied, this mass will be set in motion, the rate of motion progressing directly as inertia is overcome. After motion has been imparted to the mass, it will continue to move unaided, as force is indestructible; but the friction of the atmosphere causes a certain amount of skin resistance, and force sufficient to balance this will have to be applied to maintain the motion, such force being wholly consumed and dissipated in the form of heat; and so it is when an electric circuit is closed through the insulated wire of an electro-magnet, the inertia of magnetism has to be overcome to allow of the motion of the electric atoms (if I may so term them) resident in matter, and all that is necessary to maintain the electric motion which has been set up is energy sufficient to balance the resistance that all conductors oppose to the transmission through them of electric motion, a resistance analogous to the skin resistance of a mass of matter moving through a viscous medium.

If the steady flow of the electric atoms be suddenly checked, then the inertia of magnetism, the equivalent of stored up energy comes into play and acts in a precisely analogous manner to the stream of a water ram when its flow is suddenly checked, the total amount of energy becomes imparted to a smaller number of the electric atoms, and consequently the electric potential is increased, such potential being increased directly as the amount of resistance opposed in its path. Magnetism and electricity appear to me to be separate forces, and they are so intimately associated with what we understand by the word matter, that the older I get the more I regard them as being a species of matter, if not actually part and parcel of it. Now, if we regard electricity and magnetism as distinct entities or atoms, then, I think, we can obtain a general comprehension of electro-magnetic phenomena, and the *modus operandi* of the transmission of force by supposing iron and magnetic substances to possess a much larger number of magnetic atoms than non-magnetic matter, and that directly as the number of magnetic atoms in a conductor, so is its resistance to sudden atomic motion or polarisation. The mass of iron composing a dynamo armature possesses a very much larger number of magnetic atoms than the insulated copper wire surrounding it, and therefore when the armature is revolved through the magnetic fields of alternate direction, the mechanical force of the engine is deflected, as it were, and instead of overcoming the inertia of the magnetic atoms and magnetically polarising the armature, it sets the electric atoms resident in the convolutions of insulated wire in motion in alternate directions instead, and conveys along with the electric currents developed the energy consumed in imparting motion to the dynamo, in a somewhat parallel manner as when an India-rubber ball is thrown against a wall, and its direction of motion, as well as the energy imparted to it, is altered.

If an electric circuit be closed through a straight conductor, the conductor exhibits magnetic phenomena, iron filings are attracted, and a magnetic needle subjected to its influence and free to move, will take up a definite position which has reference to the direction of the electric current. If the conductor be insulated with cotton or silk and wrapped so as to form a solenoid, there will be an increase of magnetism produced when the electric circuit is closed through it. This arises from two causes: 1st, the magnetism developed is concentrated in a smaller space; and 2nd, as a consequence of this concentration, arising from the greater contiguity of the coils, they are brought more under the influence of one another and act inductively and thus enhance the magnetism produced.

It will be observed if the circuit through the solenoid be divided, the spark produced in the act of breaking contact will be a heavier one than occurs if the battery wires be simply brought together and separated without including the solenoid in circuit.

If the solenoid be placed in the interior of a second solenoid and the circuit of No. 2 solenoid be closed through a galvanometer, a momentary deflection will be observed on closing No. 1 solenoid in the battery circuit, and a second momentary deflection of the galvanometer needle, but in the opposite direction, will be noticed when the battery circuit is broken.

It will be further observed that the spark produced by the division of the battery circuit through No. 1 solenoid is greater if No. 2 solenoid is open at the time, than the spark produced if No. 2 solenoid circuit be closed.

If a cylinder of soft iron be inserted in the interior of No. 1 solenoid, then all the phenomena which have been just described will be observed, but in a greatly enhanced degree. Further, it will be observed, that if the circuit through No. 1 solenoid be opened and closed rapidly, or if currents be sent through it in alternate directions, the soft iron core will be found to have become heated, and that the heat developed will be greater if the circuit of No. 2 solenoid be kept open, than the heat that is developed when No. 2 solenoid circuit is kept closed.

If the iron cylinder be replaced by a core composed of fine iron wires, then all the effects above described will be still further enhanced, with the exception of the production of heat in the iron core which, if not now actually imperceptible, will be found to be very much reduced.

I need not enter into detail as to how the phenomena referred to are produced, for what has been stated is common knowledge to most of your readers; but what I do want to direct attention to is that there is too great a tendency for those trained in the schools to regard such phenomena separately, instead of grasping them as a whole and perceiving that they are simply incidents arising out of first principles.

For example, scientists speak of extra currents, secondary currents, and Foucault currents as distinct from one another, and we have had lately added to this list self-induction, and new terms suggested to be used in connection with it.

Now I venture to assert extra currents, secondary currents, Foucault currents, and self-induction are produced in the same way, and that they are all referable to the inertia of magnetism.

Prof. Hughes's researches demonstrate, as might be naturally expected, that the conditions most favourable for the exhibition in a conductor of what is called self-induction is the exact converse of that for the development of magnetism in a mass of soft iron.

A solenoid of copper wire will, I venture to say, exhibit more powerful self-induction than a straight wire, and for the same reason that more magnetism is developed by a helix than a straight conductor.

For the development of what is termed self-induction in a straight conductor, a cylinder is the best form, as the molecules of which it is composed are in closer contiguity in a cylinder than in any other shape, and consequently the conditions for magnetic induction between the molecules are more favourable. On the other hand, a ribbon conductor is the one in which the molecules are separated to the greatest extent, and therefore the conditions are the most unfavourable for magnetic induction between the molecules.

If an electric current, which may be termed the magnetising current, be sent round a soft iron cylinder, as a consequence of the inertia of magnetism a temporary current is set up in the iron and passes round it in an opposite direction to that of the magnetising current, and a solid cylinder of iron is the best form for favouring the development of such temporary currents.

If the cylinder be replaced by a bundle of iron wires, the temporary currents set up round the wires pass each other in opposite directions and neutralise one another, and the tendency to form such currents is consequently checked.

If an electrical current be sent through a cylindrical conductor, rings of magnetism will be formed at right angles to the direction of the current, and these rings, which we will call magnetic currents, will flow round in a uniform direction.

FIG. 2. FIG. 3.

If, however, the solid conductor be replaced by a bundle of conductors formed of wires of small sectional area, then the tendency to form magnetic currents will be greatly interfered with, as the magnetic currents formed in each wire will be in the opposite direction to that of its neighbour, or more correctly, will pass one another in opposite directions and neutralise one another. Fig. 2 represents a cylinder of iron in the act of being magnetised, the arrows indicate the temporary or, as they are termed, the Foucault currents flowing in the interior.

Fig. 3 represents a bundle of iron wires in the act of being magnetised. It will be seen by the arrows that whatever currents are set up oppose one another, and therefore tend to stop their formation.

Now if fig. 2 be regarded as a cylindrical conductor, the arrows will indicate the magnetic currents flowing in a uniform direction, which develop magnetism also in a uniform direction, and favour self-induction; and if fig. 3 be regarded as a conductor composed of a bundle of wires, it will be seen that the tendency to form magnetic rings is prevented, as the direction of the magnetism which would be developed in any of the conductors would be balanced by that developed by its immediate neighbours, and therefore the conditions are not favourable for magnetic polarisation, or, as it is termed, self-induction.

(*To be continued.*)

COMMENTS ON A CABLE COMPANY.

THE ordinary general meeting of the Direct United States Company has been held, and we think the shareholders have no cause to congratulate themselves upon their position according to the report. No doubt a substantial reserve fund, kept solely for the purpose of laying new cables and repairing those already laid, is as essential to a submarine telegraph company as the maintenance of a sound mind in a sound body is to any reasonable person. With what care, then, should such a fund be guarded in any case, and measures taken to see that it is not diverted into other channels than the legitimate ones for which it is sooner or later sure to be required, but especially by a company which possesses only one cable, and that at the present time useless, its repairs involving a large and daily increasing expenditure with the risk that after all they may prove unsuccessful. We have weighed carefully the pros and cons, and the balance has so decidedly turned in favour of the latter, that we shall be surprised to hear that the old cable has been resuscitated by the insertion of the 300 miles of new cable which we hear the repairing ship has on board for that purpose.

It is said that history repeats itself, but we hope that it will not do so with regard to the manufacture and laying of many cables we could mention.

The one and only cable of the Direct United States Company has a curious history. The Atlantic Telegraph Company having accepted a cable more for its suitableness to catch subscribers than for its absolutely substantial qualities, found themselves in consequence floundering in a very "slough of despond," when the Anglo-American Company came into existence and took up the running. To their credit be it said they carried the cable to the desired goal, thus achieving a long desired object with a great success.

Having run the risk it was thought with justice that they deserved the prize, and this they would no doubt have enjoyed much longer than they did had not the inhabitants of both hemispheres had good reason to complain of their grinding monopoly.

It was for the purpose of introducing a sound commercial principle of healthy competition that the Direct United States Cable Company was started, and in January, 1874, the manufacture of their cable commenced, the conductor and the proportions of copper and gutta-percha being different from those used by the Anglo-American Company, the outer covering also had an addition. These differences were considered to be vast improvements upon the old form of cable, and we think that time has proved at least some of them to be so. The laying of the whole of this cable between Ireland and America was not completed until September 6th, 1875.

The contractors being new to such a long length of cable to be laid in so great a depth of ocean, were naturally anxious that all things should be done well. They therefore proceeded on the slow and sure principle, a very laudable one on all occasions, but especially, we think, in the manufacture and laying of submarine telegraph cables, which certainly are not improved by the hurry-scurry system usually adopted. On the 13th of the same month the cable was opened to the public, and many messages sent and received between London and New York in such quick time that the old route *viâ* Newfoundland was considered slow.

Sir W. Thomson went to Ireland, and on the two following days tested the electrical condition of the cable. He concluded a most elaborate report upon the subject as follows :—

"In conclusion, I am glad to be able to say that my tests proved the cable to be in perfect condition as to insulation, and showed its electrostatic capacity and copper resistance to be so small as to give it a power of transmitting messages which, for a trans-Atlantic cable of so great a length, is a very remarkable as well as valuable achievement."

This cable continued to work well, causing in the minds of those interested in the Anglo route as much consternation as would be felt by a weaver if some designing person had placed a discordant thread in his warp, while he, all unconscious, plied his shuttle, not discovering until too late that his design was considerably interfered with. Fortunately for them, however, the Direct Cable at length broke, placing the company *hors de combat*. The break was repaired as quickly as possible, being in comparatively shallow water, and the working again commenced, but soon another break occurred. This was repaired in the same way, but had not long continued to transmit messages with the same speed and accuracy as at first, when a third break of a similar kind was discovered, close to the other two fractures.

Three cuts, for such they proved, occurring so quickly in succession, suggested the idea that they were caused by foul play: the company therefore called to their aid Sir W. Thomson and Mr., now Sir Frederick Bramwell, to investigate the matter, and in a very clear and distinct report they say :

"At the risk of repeating ourselves, we think it well to state definitely here, after recording this last test, that our experiments and examinations of the cable convince us it is one of an extremely strong form, that it has suffered no deterioration whatever from its immersion for a period of about a year and a half in the sea, and that the fractures have been caused by violence applied by an implement and not by decay, and not by any abrasion, or rubbing, or any influence of that kind.

"It is to the scrupulous care which has been exercised to prevent any fault, however minute, from being left in the cable, that the chief delay in its completion was owing.

"We think the contractors deserve great credit for their unfaltering determination, however deep the water, and however small the fault, to slur over nothing, and for the great efficiency of the means (material and personal) with which they carried on the operations, often in very heavy weather, and much of them in winter, and for their final success in giving you a thoroughly perfect cable."

It is a significant fact that after this report no more cuts occurred.

After the third interruption was repaired the cable was tested from the Irish end by Mr. F. Jamieson in a similar way to that adopted previously by Sir William Thomson, his report upon the quality of the cable being as favourable. Soon after this all other systems failed for 144 hours, the Direct Cable easily doing their work in addition to its own at a rate of 18 words per minute. Many of the messages were delivered between London and New York in less than five minutes, thus proving that one good direct cable was quite sufficient for all requirements if properly worked.

When the repairs of the other systems were completed, it was mutually agreed that both companies should work amicably at an uniform tariff of 3s. per word. But this agreement did not last long, as each company accused the other of unfair dealing; so on February 23rd, 1877, the Anglo-American Telegraph Company issued a circular to their shareholders informing them that at a special meeting of the board of directors held that day they had resolved :—

"That every effort having failed to induce the Direct United States Cable Company to adhere to an uniform tariff for messages, the tariff be reduced to *one shilling* per word on and after 1st March, 1877."

So the price was reduced to 1s. per word and the tariff war commenced, hostilities raging more furiously than ever. As to capital involved, the Anglo-American Company was greatly handicapped, so no wonder they soon found the low tariff not sufficiently remunerative, and tried other tactics to increase the rates and bring the shareholders to their way of thinking.

The honest shareholder in either company must have been sorely confused as to the safest path for him to take, considering the diversity of opinion on the subject conveyed to him in printed circulars by nearly every post from those, each of whom, professed to be the only true and reliable guide.

Suffice it to say that eventually in June, 1877, electricians on behalf of the Anglo-American Company pronounced the electrical condition of the Direct Cable satisfactory, and from that time the company formed one of the links in the chain the Anglo-American Company were forging. In other words it joined the "Pool" which, as we understand it, is a combination to secure monopoly, a proceeding not in accordance with the views of a writer of one of the many pamphlets circulated so freely among the shareholders in the Atlantic Telegraph Companies in 1877, who says : "I am convinced, moreover, that an amalgamation of the two companies would inevitably call into existence fresh competing lines, and thus the contest between speculators for monopoly, and the telegraphing public (desiring to have two strings to their bow) would only lead to an excessive enlargement of the total capital employed in Atlantic telegraphy, and to a further decrease of public confidence in this species of enterprise."

We believe there are but few investors in the same property now who will not agree with his opinion.

We hope, if time permits, to resume this subject in our next number.

EXPERIMENTS WITH 480 H.P. TURBINES AT OLCHING.*

By G. R. B., in the *Practical Engineer.*

THE installation consists of two turbines, one of the Jonval and the other of the Girard type, with vertical axes enclosed in wooden chambers. The latter were originally made for a smaller quantity of water, but to avoid costly alterations it was decided to construct the two motors, with which the trials were carried out, to suit existing arrangements. Under ordinary circumstances, for about nine months out of the year, the quantity of water available is from 565 to 600 cubic feet per second; in dry seasons this is reduced to from 350 to 390 cubic feet, and in very extreme cases, which, however, only last a short time, to 250 cubic feet. The fall is 9 feet 6 inches, and invariable.

The two turbines are so designed that with the normal quantity of water both work together with full admission. When the supply of water diminishes, the Girard wheel, which is the smaller, is regulated by closing some of the guide passages. The manufacturer, Mr. J. G. Landes, of Munich, guaranteed the following results :—

(1) With both wheels working at full power with the normal quantity of water an efficiency of 75 per cent.

(2) With the Jonval wheel full, and the water admitted to two-thirds of the passages of the Girard wheel, 74·6 per cent.

(3) With the Jonval wheel full, and admission to one-third of the Girard wheel, 73·8 per cent.

(4) With the Jonval wheel alone 75 per cent.

The Jonval turbine was designed to develop at least 300 H.P.

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* Foreign Abstracts. Proc. Inst. C.E.

under all circumstances, and the other motor to utilise the remaining energy. The following are the leading dimensions of the two wheels :—

JONVAL TURBINE.

Angle of outflow from guide passages	18° 50′
„ „ „ wheel buckets	16° 37′
Mean diameter of wheel..................	11 feet 1·86 inches.
Width of buckets..........................	2 feet 7·7 inches.

The wheel is divided by a partition into two concentric parts of unequal width; for the outer of these the number of guide vanes is 30, the number of wheel buckets 38; for the inner portion the corresponding numbers are respectively 23 and 29.

GIRARD TURBINE.

Angle of outflow from guide passages	24°
„ „ „ wheel buckets	36°
Mean diameter of wheel..................	9 feet 6·38 inches.
Width of buckets at top.................	0 feet 11·81 inches.
„ „ „ bottom...........	2 feet 5·14 inches.

For measuring the effective power of the motors a Prony brake was employed, the brake wheel having a diameter of 7 feet 2·61 inch. The only available place for the application of the brake was on the horizontal first-motion shaft, driven by bevel gearing from the vertical turbine shafts, and it was therefore necessary to allow by calculation for the friction of the gearing and horizontal shaft to arrive at the power actually developed; in doing this a coefficient of friction of 0·07 for the bearings, and 0·13 for the bevel gearing, was allowed.

The quantity of water used was measured by means of current meters in the head race, the total section of the channel being divided into 28 rectangles, in each of which the velocity of flow was observed. As a check upon the accuracy of the results, three instruments by different makers were used simultaneously.

Owing to the absence of a weir in the tail race, by which the level of the water could be regulated, the Girard wheel had to work partly immersed, and the Jonval wheel (3·86 inches) clear of the tail water, and the efficiency of both turbines was thereby somewhat reduced.

The following are the results of the trials :—

No. of Trial.	Mean number of revolutions per minute.	Effective H.P.	Head of water.		Quantity of water used per second.	Available H.P.	Efficiency.	Remarks.
			Ft.	Ins.	Cubic feet.		Per cent.	
1	69·0	472·24	9	3·7	595·86	629·35	75·0	Both turbines together.
2	70·5	481·70	9	5·2	583·57	624·72	77·1	
3	73·5	365·62	9	11·9	401·12	458·33	79·8	Jonval turbine alone.
4	72·0	364·43	9	11·9	404·62	458·92	79·4	

If allowance were made for the height of the Jonval wheel above the tail water, the efficiency would be 83 per cent., instead of 79·8. The number of revolutions given represents those of the brake-shaft; the latter was geared with the shafts of the Jonval and Girard wheels in the ratios of 44 to 112 and 40 to 108 respectively.

THE LONDON CHAMBER OF COMMERCE ELECTRICAL SECTION.

THE preliminary meeting of the Electrical and Allied Trades Section was held on Friday, the 27th July, at 3 p.m., there being present, Messrs. Mark Parker, R. E. Crompton, E. Garcke, H. S. Price, J. C. Fell, E. J. Paterson, H. J. Dowsing, Major S. Flood Page, S. Drugman, A. P. Trotter, H. C. Harold, G. C. Fricker, R. W. H. McDowell, J. Appleton, A. R. Margary, C. J. Appleby, J. C. Mewburn, H. Alabaster, T. E. Gatehouse, C. S. Wharton, M. Immisch, Major-General C. E. Webber, C. Dexter Barker, Robert Macpherson, A. Reckenzaun, Ernest Wahrig, J. F. Albright, J. G. W. Aldridge, S. P. Wilding, H. South, F. R. Reeves, C. P. Elieson, G. C. Fraser, C. W. Rausch, Mr. St. Geo. Lane-Fox, F. C. Nielson, C. S. Cooper, W. H. Snell, J. Stephens, J. Irving Courtenay, C. D. Richardson, A. Whalley, R. Applegarth, Basil Gee, F. Hubel (Immisch & Co.), F. L. Rawson, W. O. Callender, Engelbert & Co., Joseph J. Richardson, and J. Annesley Grindle.

The proceedings opened with a resolution by Mr. Price, seconded by Mr. Garcke and carried unanimously, "that Mr. Crompton act as chairman of the meeting."

On taking the chair, Mr. Crompton explained that two previous meetings had been held; the one at which members of the Chamber only who were interested in the electrical trade were present, and the other an informal meeting in the shape of a dinner held at the Holborn Restaurant. At both of these meetings a strong opinion had been expressed in favour of the formation of an Electrical Trades Section in connection with the London Chamber of Commerce. (He then called upon the secretary to read the minutes of the meeting of the 13th July, which was accordingly done). Continuing his explanations, the chairman said he had never himself known more unanimous opinions than those to which he had referred. He did not advocate the appointment of permanent officers as yet, because the country firms were not fairly represented at the meeting. He did not think that the officers should represent London only. Nevertheless, he thought it would be advisable for a committee to get to work without delay, and he would therefore ask those present to express their views, as there would be important questions coming up for legislative settlement in the autumn.

Mr. LANE-FOX said it was well that the trade should at this stage have a clear conception of what they wanted; he would suggest a clear definition of what were the common interests of the trade. If an understanding were thus arrived at as to what their common interests were, it would tend to diminish antagonistic feeling, and would clear the way for some satisfactory action on the part of the committee. His own opinion was that they should have a standing committee which should report the difficulties met with in industrial operations, and that members of the Chamber should have the right to submit subjects for consideration by this committee.

Mr. PRICE thought their first object should be to get members to join the proposed section, and that that day's discussion should bear upon matters of formation.

General WEBBER thought the best way of avoiding that suspicion which is generally attached to new creations would be to clearly define the duties of the committee of management. He thought that on all general questions every member of the section should have an opportunity of participating in the discussion and, as far as possible, of joining different sub-committees, as otherwise members of the section who were not members of the committee might disagree with the conclusions arrived at by the working committee.

Major FLOOD PAGE, with a view of bringing the discussion to a head, moved a resolution for the formation of an organising committee of six.

Mr. GARCKE seconded the resolution.

Mr. RAWSON moved an amendment to this resolution in the shape of an addition that the committee be empowered to add to their number.

Major FLOOD PAGE accepted this amendment as an addition to the original resolution.

Mr. PRICE thought the committee should not be limited to six members, an opinion with which Mr. Rawson agreed, and said he was prepared, if necessary, to move an amendment extending the number.

It was agreed that the committee should consist of 12 members, and a resolution was unanimously passed in the following terms :—

"That an organising committee of 12 members representative of the electrical trades be appointed this afternoon with a view to organising an electrical section under the London Chamber of Commerce, such committee to report to a meeting of the electrical trade about 15th September, and the committee to remain in office only until a permanent committee be appointed. The committee to have power to add to their number."

It was then agreed that a ballot should be taken for the nomination of the 12 members of the committee, and Mr. Murray, the secretary to the chamber, and Mr. Price were appointed scrutineers. After an interval the result of the poll showed that Messrs. Crompton, Flood Page, Rawson, Garcke, Price, Webber, Siemens, Trotter, Wharton, Gatehouse and Callender were elected members of the committee, and that a tie existed between Messrs. Immisch, Gray and Courtenay. It was decided that all three of the latter gentlemen should be added to the committee. It was thus finally composed of 14 members, instead of 12 as originally designated in the resolution. It was decided that the secretary should advise these gentlemen of their election, and on hearing of their acceptance, or otherwise, should convene a meeting after consultation with Messrs. Crompton and Garcke.

The proceedings then terminated with thanks to the chairman and the scrutineers.

THE COX-WALKER SWINTON MAGNETO BELL SYSTEM.

THE advantages of magneto bells over electric bells requiring a battery to work them are well known. The ordinary electric bell battery cannot well be sent out ready for use, but must be charged after it reaches its destination, and in hot weather it may dry up, and refuse to act. After a time it must be recharged, and in a few years it is worn out, and must be renewed entirely. Magneto bells are free from these disadvantages. The electric current that operates them being generated by the motion of a coil of wire in relation to to a permanent magnet, both of which, if properly constructed, are practically everlasting, the bells will work for years without requiring attention. Hitherto, however, magneto bells have been too complicated and cumbrous for ordinary use, while their considerable expense, as compared with the ordinary electric bell system, has rendered them inapplicable to domestic and similar purposes. Their employment has therefore been almost entirely confined to telegraph and telephone work.

The magneto bell system of Mr. E. Cox-Walker and Mr. A. A. Campbell Swinton has been designed to obviate this, and comprises generators and bells, which are exceedingly simple, inexpensive, and easy to work, and, while possessing all the advantages of the older forms of magneto bells, are entirely suited for domestic use, and for all the manifold purposes for which electric bells of the ordinary battery kind have hitherto been employed. In this system the magneto generator (see fig. 1), which takes the place of the push button and battery used with ordinary electric bells, is of extreme simplicity. It consists of a single horseshoe permanent magnet, fitted with soft iron pole pieces, between which is pivoted a Siemens armature, composed of a soft iron core, in the shape of a shuttle, wound longitudinally with insulated copper wire. In connection with this armature is a small brass handle, by means of which the armature is easily rotated backwards and forwards through a small arc. There is no gearing, and the parts mentioned, together with a pair of brass terminals in connection with the two ends of the wire on the armature, and serving for the attachment of the double wire leading to the bell, comprise the whole transmitting apparatus. The generator is simply operated by taking the small handle between the finger and thumb and giving it a rapid to-and-fro motion. This movements generates electric currents in the armature wire by electro-magnetic induction, and these currents pass away through the terminals and double connecting wire to the bell at the other end.

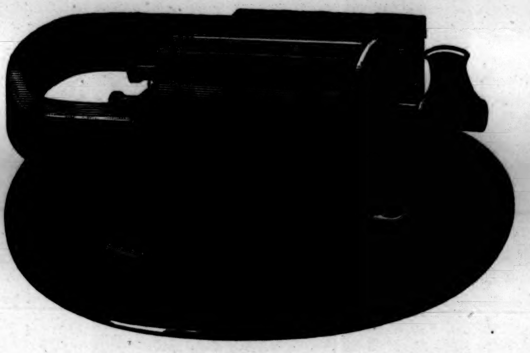

FIG. 1.

Several types of bell are manufactured to suit different requirements. In each there is an electro-magnet, in front of the poles of which is pivoted an armature carrying a hammer, the core of the electro-magnet and the armature being kept continually magnetised by means of a small permanent magnet. When the generator is operated the electric currents pass round the wire on the electro-magnets, and, being of varying strength and direction, cause the armature and hammer to vibrate. In some cases two gongs, as in fig. 2, are employed, with the head of the hammer placed between them, so that each gong is struck alternately. In simpler forms there is only a single gong, which has two projecting tongues cast on its rim, the hammer head being arranged to strike first one tongue and then the other as it vibrates. In one type of bell on this principle the magnets and other mechanism are all contained under the gong—a very compact arrangement. The bells will work through circuits many miles in length without the slightest difficulty.

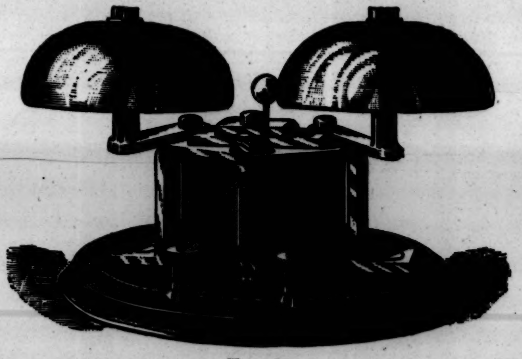

FIG. 2.

THE METROPOLITAN ELECTRIC SUPPLY COMPANY, LIMITED.

THE electric light boom has again set in, and the prospectus of the above company is consequently before us. The nominal capital is £500,000 in £10 shares, and is to consist of 49,900 ordinary shares and 100 fully-paid founders' shares. Forty-three thousand nine hundred ordinary shares are now offered to the public.

An apparently attractive paragraph printed in red ink immediately follows the above information, which states that "*more than one-half of this issue will be applied for by some of the directors and their friends interested in the establishment of the company, on the terms stated in this prospectus, but without their being entitled to any preference in allotment.*" In plain words, we suppose about half the capital offered is underwritten. We will now proceed at once to consider some of the items in the prospectus in the order in which they come.

The directors claim to have been associated with the progressive development of electrical science, and to have been pioneers of submarine telegraphy; but we should rather think that those of them who have been most interested in submarine telegraphy, with only one or two exceptions, should be termed pioneers of a system for the prevention of too full dividends on a notoriously risky class of commercial undertaking.

Item 2 states that the belief of the directors is "founded upon the recent remarkable developments in electric engineering, both in storage batteries and improved means of distribution, which now enable electricity to be supplied like gas over large areas from central stations, at rates which will attract consumers and be remunerative to the company." We fail to perceive that there has been any great advance worthy the name in storage batteries, and we do not see that rates twice the price of gas will attract consumers. Perhaps, however, other considerations may.

The directors, in the third paragraph, consider, "from actual instances, that the proprietors of many buildings which are already lighted by their own electric plant will prefer to avail themselves of the advantages offered by the company," but we very much doubt if many of those who at present have plant down will feel disposed to sacrifice it to connect on to a new system.

Notices appear to have been served on quite a number of local authorities, signifying the intention of the company to apply for Provisional Orders, but pending the obtaining such orders licenses have been applied for.

The company has entered into an agreement to purchase the undertaking of the Whitehall Electric Supply Company, Limited, the price fixed by the vendors being £79,888 (£19,888 in cash, and the balance in cash or shares at the option of the company), and the vendors are also entitled to subscribe for 50 of the founders' shares. It would be interesting to know what is to be obtained at Whitehall for this large sum.

Perhaps the most fortunate allusion in the prospectus is that to the fact that the company is not committed to any particular patents or systems, but is quite free to adopt any system which promises favourable results. In this respect the company will have a decided advantage over those in which the public sank such immense amounts a few years ago in companies which have nearly all dwindled into what they should have been from the first, namely, contracting and manufacturing companies, rather than companies for the supply of light.

The magnitude of the proposed undertaking, and its possibilites of profit, are illustrated by a reference to the called up capital of the gas companies and to the dividends paid by them, but we fail to see the applicability of the reference.

As regards the experience of companies in the United States, the figures are open to the gravest doubt; we have no knowledge of large electric light companies paying such dividends, and the majority of those named are apparently small local installations, and should not be compared with what the company proposes to do in the metropolis. Gas, too, in some of the towns quoted, is from three to six times the price of that supplied in London.

In reference to the large field for electric motors, too much reliance must not be placed on it; what may be largely used in America is not necessarily sought after here where conditions are different, and motor work will probably develop but very slowly for some time to come.

Dr. John Hopkinson is quoted as having "great confidence that electric lighting on a large scale in the metropolis can now be made to pay well." We should like to know the grounds for Dr. Hopkinson's confidence; none are given.

The capital of the company we have previously stated, and it appears that the 100 founders' shares will receive no dividend in any year until 7 per cent. for the year has been paid on the ordinary shares, after which they will take half the surplus profits.

We shall note the progress of this company with much interest; but a dividend long deferred, and then only at a telegraph companies' rate of 5 or 6 per cent. or less, will not recoup the first investors for the very considerable risk they must of necessity run before obtaining it.

The financial and speculative, rather than the truly commercial element, is too strongly represented on the board, and we therefore have misgivings as to the future of this company, which even the respected names of the distinguished men associated with the scheme as consulting engineers entirely fail to remove.

CROMPTON & CO., LIMITED.

THE firm of R. E. Crompton & Co. will henceforth take on the affix of Limited, and be known as at the heading of this. The issue of the prospectus to the public had been expected for some time past, but the directors have decided, in view of the lateness of the season, to postpone the public issue of it until later, when it is anticipated that the capital will be readily subscribed; but inasmuch as a considerable number of shares have been already privately taken up, and delay in commencing the operations of the company is likely to prove prejudicial, the company has been registered, and the preference shares now subscribed for will be allotted.

Messrs. R. E. Crompton & Co. have agreed to accept part payment (£25,000) now and to wait for another similar portion in cash.

As the prospectus is not made public we refrain from criticising it in detail, but we sincerely hope that this, one of the soundest and one of the most straightforward constructing companies, may meet with the success it deserves.

The gross profits seem to have been good for years past, and the net profits, of recent times at least, very satisfactory; there is one omission from the prospectus privately issued and in confidence, and that may perhaps be rectified in the issue later on to the public, namely, the remuneration to be paid to the directors and also to the managing directors. The latter have not, of course, included their drawings in the expenses set against gross profits, nor do we suggest that they should have done so, but their remuneration in the future must affect the dividend-paying prospects, and therefore should, we think, be stated.

The allusion to *several hundreds* of such companies in the States, all of which are paying *steady dividends*, we think is hardly warranted, and savours too much of the visionary boy who saw *thousands* of cats on the 10 feet length of his back garden wall.

The cash consideration (in addition to shares) to be paid to the vendors is high, and it is open to question whether the vendors will retain as much interest as they now do in their work when the company takes over the business. On the face of it, it seems as if the present partners will take too much out of the capital subscribed; but possibly there may be reasons for their so doing, which cannot, from the nature of them, be put into a prospectus intended for publication.

Without doubting the valuations of premises by Mr. John Slater, F.R.I.B.A., and of plant by Messrs. Wheatley Kirk, Price & Co., we think it would be well to state the amount of the said valuations.

The concern is undoubtedly so good a one that the vendors can well afford to give such information, and we should think advantage the prospects of the new company in so doing. As an investment it has far superior recommendations to that of any company established merely for the supply of light from central stations.

NOTES.

Proposed Electric Lighting at Southampton.—On Monday, at a meeting of the council of the Southampton Hartley Institution, a letter was read from the Town Clerk, stating that the Corporation intended to apply to the Local Government Board for sanction to borrow the sum of £1,440, being the estimated cost of lighting the Audit House, Hartley Institution, Guildhall, the clock in Holyrood Church, and the lamp at the top of Bridge Street with the electric light, and enquiring if the council were prepared to consider the desirability of that institution being supplied with the electric light, and also in what manner it could be carried out. The borough surveyor would be happy to confer with them on the subject. Mr. J. E. Le Feuvre, the Chairman, in proposing the reference of the letter to the Finance and General Purposes Committee, said that the Corporation had a large amount of surplus power which they were prepared to utilise at a comparatively small cost for electric lighting. By joining in the scheme the Hartley Institution would eventually effect a great saving in expenditure, although there would be necessitated at the outset a serious outlay for fittings. It was stated that the present annual cost of lighting the institution by gas was about £70 a year. The electric lighting company in course of formation at Southampton had had nothing to do with the matter. The motion was carried.

Lightning and the Electric Light.—The enlightened *Journal of Gas Lighting* publishes the following paragraph:—"The residence of Sir Albert Sassoon, in Eastern Terrace, Hove, narrowly escaped destruction by fire on the night of Sunday, the 22nd inst. During the heavy thunderstorm which occurred that night, one of the maids, who had been roused by the storm, was startled by a smell of fire coming from the entrance hall, which is lighted by incandescent electric lamps. The girl called the butler, who found that flames were flickering near one of the lamps. He poured some water upon the spot, and in this way the outbreak was checked. One of the lamps was broken, and the woodwork near it scorched. It is supposed that the wire was struck by lightning, which was thus conducted into the house." This is supposition with a vengeance. There may have been a fault in the wire and overheating, but to suppose that lightning had aught to do with the accident is pure folly.

Electric Lighting in Birmingham.—The Corporation Street Estate Company, Limited, which is building an important block of shops and offices in Corporation Street and Martineau Street, has decided to light the new buildings with electric light. There will be 20 shops and 64 offices in the block, which will be fitted with incandescent lamps, and the tower will be surmounted with a powerful arc light. The dynamos and the electric fittings are being supplied by Messrs. Elwell-Parker, Limited, of Wolverhampton, and the engines, which are compound and of a semi-portable make, are being built by Messrs. John Fowler and Company, Limited, of Leeds. The whole of the electric machinery and fittings are being erected under the supervision of Mr. T. C. Sharp. We understand that arrangements will be made to supply the electric light to some of the adjoining business premises.

The price at which current is proposed to be supplied at Birmingham, under Messrs. Chamberlain and Hookham's scheme, has now been fixed at 8d. per unit, which is equal to a little less than ½d. per hour for incandescent lamps of 18 candle-power, and about 4d. per hour for arc lamps of 2,000 candle-power.

Bath and the Electric Light.—At the fortnightly meeting of the surveying committee of the Bath Town Council on Monday a communication was received from the Town Clerk formally stating that the Town Council had decided to light certain thoroughfares with electricity, and that the arrangements were left to the surveying committee. The Mayor thought it would be best to elect a special electric light committee, the members of which should not be interested in the gas company or the electric light company. The following were proposed by Mr. Sturges as the members:—The Mayor, Alderman Gibbs, Captain Franklin, Messrs. Moger, Collins, Ricketts, and Sturges. Mr. Cox was added to the names proposed by Mr. Sturges, and it was decided that the committee should meet as soon as possible.

The Electric Light in Paris.—The *Daily News* states that the Paris Corporation held on Friday night the closing sitting of its extraordinary session. It rejected two applications for a concession to light Paris by electricity, the contractors not having followed the specifications laid down by the Municipal Council, and voted a grant of £40,000 for the erection within the Halles Centrales of electric works for the supply by mains of the whole city. It is doubtful, however, whether the Government will allow the Corporation the exercise of such a monopoly.

Dublin and the Electric Light.—A special meeting of the Dublin Town Council was held on Friday, the 20th ult., to consider and take action on the letter of the Board of Trade, notifying that it is proposed to proceed to issue to the corporation a licence for electric lighting, subject to conditions as assented to by the representatives of the corporation at the meeting at the office of the board on the 3rd inst. Mr. Robinson moved: "That the conditions contained in the letter of the Board of Trade, dated the 10th of July, be accepted, and that they be requested to issue the licence in accordance with the conditions, and so far as the completing of the installation at present contemplated, within 2½ years, the council desires that the clause of the licence should be so framed as to leave it open to the council to make subsequently such further extension of this system in the streets as from time to time they may consider advantageous." The motion was agreed to.

The Telephone in the West.—We learn that the Western Counties and South Wales Telephone Company has decided to immediately commence the construction of trunk lines which will connect Tavistock, Ivybridge, Totnes, Paignton, Torquay, and Newton Abbot with the Plymouth and Three Towns Exchange system. This decision has been arrived at without any rental guarantee whatever from the public. Call offices are to be opened in each place.

United Telephone Company.—A "communicated" article in the *Financial News* of Thursday must prove pretty much of a revelation to the shareholders, and we doubt if the directors will be pleased with the exposure of the real proportions of the business they do and the remuneration they take. Since 1883 £285,520 have been paid in dividends; but in the same period £200,376 has been received in dividends and royalties from subsidiary companies, and about £33,807 has gone to the board in fees and allowances. Last year, excluding the sub-companies' contributions, the profit earned by the board on the London business was £15,263, while the directors took £10,000 in fees!

The Atlantic Cable Rates.—A *Daily News* New York telegram says:—"An agreement between the cable companies was completed to-day by the signatures of the Western Union and Commercial Cable Companies. The full text has not been made public, but the differences that caused the delay are not material. The agreement goes into effect on September 1st instead of August 15th, as previously reported. The land rates have been adjusted on nearly the same basis as when the rate was 60 cents. New York city is made the southern limit for all the cable companies. The announcement exerted a favourable influence on stocks, although Western Union responded but slowly."

Old Brushes for New Ones.—Our youngest weekly contemporary, the *Electrical Engineer*, noticed in its last issue a new invention, attributed to Mr. Crompton, which will assuredly effect a revolution in brushes, whether for the toilet or for dynamos. They are made, so it is said, of wire gauges cut on the diagonal of the mesh (termed "on the bias") laid together in strips, folded over once or twice and soldered firmly down. Wire gauges have been a bone of contention for years past so far as their ostensible purpose is concerned, and we are glad to see that no matter whether of the B.W.G., standard, American, or any other type, they can now all be soldered together for a useful purpose. We venture to suggest that wire gauze might answer the purpose equally well and produce "a perfectly flexible brush with innumerable points of contact," and which would reduce the sparking to minus something, but we do not for one moment wish it to be thought that we would pit our experience in these matters against that of Mr. Crompton.

Turbine Efficiency—A number of letters have recently passed in one of our engineering contemporaries respecting the most economical methods of transmitting power, and turbines were, amongst other things, mentioned as prime motors. Doubts have always been expressed as to the actual efficiency of turbines, so the results of some tests made with two different types of large horse-power, which may be found in our other columns, will perhaps prove of use.

Death from Lightning.—Last week a man, supposed to be an insurance agent from Eccles, was struck dead whilst taking shelter under a tree at Urmston during a thunderstorm.

Electric Engines on the North Metropolitan.—At the half-yearly general meeting of the North Metropolitan Tramway Company on Wednesday, Mr. G. Richardson, the chairman, said with regard to the experiments which had taken place with the Elieson Electric Company's engine, they might be described as full of promise, and he trusted that shortly they might be in a position to substitute electric engines for horses which, when they were not running, were eating their heads off in the stables.

Gülcher (New) Electric Light and Power Company.—An ordinary general meeting and a special general meeting of this company are announced for Thursday next, at the Cannon Street Hotel. At the latter meeting resolutions involving amendments of the articles of association will be proposed.

The Waterhouse Arc Lighting System.—Messrs. Shippey Brothers, Limited, inform us that they have been appointed European agents for the Waterhouse Company, whose works are situated at Hartford, Conn., U.S.A., and whose system has made great strides in America during the past two years. The Waterhouse Company makes a speciality of 30, 50, 100, and 200 H.P. central station plants for town lighting. It guarantees to run 90 of its new 1,700 C.P. Reliance arc lamps with an expenditure of 50 horse-power. We fear that much reliance cannot be placed on this statement.

New Companies.—The returns made up to Tuesday evening at Somerset House for limited liability companies showed a considerable falling off in number and stamp duties. After the extraordinary pressure immediately before Mr. Goschen's new tax came into operation this is not to be wondered at. But still there is a very full list of new companies. The aggregate amount of their capitals for the month just ended is £12,669,689. The amount received by the Chancellor of the Exchequer under the new tax of £1 per £1,000 of nominal capital registered is £12,670.

High Candle-Power Incandescent Lamps.—We are informed that at a convention of patent experts recently held at Washington, U.S.A., and which was appointed by the trade to discuss the validity of certain claims in dispute in connection with and relating to incandescent lamp manufacture, the award was given to Shippey Brothers, Limited, of London, as assignees and sole owners of the Zanni-Shippey patents, No. 5,955 of 1883, and No. 11,802 of 1887, which combined patents were said to be the only ones which describe a system for making high candle-power lamps for incandescent electric lighting.

Electric Traction in Philadelphia.—Reckenzaun's electric cars have commenced running on the Lombard and South street lines in Philadelphia. Those for the Lehigh Avenue lines of the same City, are well advanced and will be in operation within a few weeks.

The Graphophone.—This apparatus, which we illustrate in our issue of to-day, has been put into the hands of Mr. Henry Edmunds for this country. He is bringing some graphophones home with him, and will probably read a paper on the subject at the British Association meeting at Bath. We take this opportunity of thanking our very friendly contemporary, the *Electrical World* of New York, for the courtesy extended to us in forwarding advance proofs of the matter from which we have abstracted our description.

The Elieson Accumulator.—We have seen a copy of the report of Prof. Marks, of Penn. University, U.S.A., upon the Elieson storage battery. After giving data as to the weight of plates, sizes, internal resistance of cells, active surfaces, efficiency in ampère hours, watts, and potential, he says :—" I am of the opinion that this cell is unrivalled in efficiency, is practically the most promising as to durability of any that I have seen, and is connected up in the most practicable manner. Its very great weight as compared with others renders necessary a larger expense at first and makes a larger draught upon its power for transporting its own weight than is necessary in some cases." Further, we give an extract from a letter addressed by Prof. Marks to Mr. W. Preston Hix :—"The Elieson battery is mechanically the best that I have seen, presenting a greater probability of durability in motor service than any as yet presented for my opinion. The slow formation of the oxide on the lead spirals will render them more durable than any oxide paste, and the circular form inserted in a square aperture gives to this battery an elasticity which will add greatly to its durability." We congratulate Mr. Elieson on getting such a favourable opinion from a gentleman possessing the scientific standing of Prof. Marks.

Electric Lighting Stations.—MOST people, if asked for an opinion as to the relative chances of success of two electric lighting companies, one with central stations in the immediate neighbourhood of its operations, and the other with a station miles away from its best customers, would give it, for many reasons, in favour of the former. The *World*, in commenting upon the "coming electric light boom," does not give this opinion in a direct manner, but it is evident, on the face of it, that such is the meaning intended to be conveyed, and it hints in view of the formation of the Metropolitan Electric Supply Company, that the lovers and patrons of electric lighting need no longer depend entirely upon the tender mercies of a West End establishment, which shall be nameless.

Electric Locomotion in Paris.—The Municipal Council of Paris is certainly not favourable to electric traction. After having some time ago rejected M. Berlier's scheme for a tubular subterranean railway, it now condemns the proposals of Messrs. Julien, Lartigue, Fournier and Broca. These gentlemen proposed to construct a preliminary aerial single rail electrical line from the Chemin de fer de Ceinture to the place du Trocadero. This section would have been completed before the opening of the exhibition of 1889 had permission been granted to them to commence immediately. This proposal, together with a request for a concession for a period of 35 years if the aerial tramway proved successful, was passed on to the council with the favourable opinion of the metropolitan commission. Notwithstanding the support of M. Donnat, the recommendations of the report were rejected and the application of M. Lartigue refused.

Electro-Therapeutics.—Some of the leading members of the medical profession are now publicly declaring that electricity is a powerful and valuable therapeutic agent. In a paper on the use of electricity in gynæcology written for the *Lancet* by W. S. Playfair, M.D., LL.D., F.R.C.P., Professor of Obstetric Medicine in King's College, it is stated that Dr. Keith, an operative surgeon who has had almost phenomenal success, said that he should consider it almost a criminal offence to use the knife before giving electricity a trial. The great surgeon Sir Spencer Wells is in favour of the Apostoli method of removing fibroid tumours, and various interesting cases are under treatment in London and in the provinces. Dr. Tivy, of Bristol, has three cases of fibroid tumour progressing successfully. Dr. J. G. D. Douglas and Mr. W. Lynd, of Bournemouth, performed the second operation (Apostoli) last Friday. At the annual meeting of the British Medical Association to be held this month in Glasgow, the following important papers are to be read : Apostoli, G., M.D., Paris, "On some Novelties in the Electro-therapeutics of Gynæcology ;" Aveling, J., M.D., "The treatment of Uterine Tumours by Electricity ;" Macintyre, J., M.D., Glasgow, "The Use of Electricity in Diseases of the Throat ;" Duncan, John, M.D., Edinburgh, "The Value of Electrolysis in Angioma and Goître ;" Macintyre, John, Esq., Glasgow, "The Electric Illumination of the Cavities of the Body," and Murray, R. Milne, M.B., F.R.C.P.E., will show an arrangement for the investigation of the action of measured galvanic and Faradic currents on tissues.

The Powers of Electricity.—The Manchester *Sunday Chronicle* contains two columns of enthusiasm by Mr. Thomas Conolly, of the firm of Shaw and Conolly, respecting the achievements and the powers of future achievement of electricity. Evidently the Manchester scribe called upon Mr. Connolly either upon one of his busy days or when he was supposed to be out.

Electrical Works.—A recent number of the *Northern Echo* contains an interesting description of the works of Messrs. Cox-Walker & Co., of Darlington. The Press generally seems determined at this juncture to do all in its power to render electric lighting and electrical power popular. This is a good sign.

A Review.—The *Gas World* writes:—"We have wasted some time in reading 'Electricity *versus* Gas,' by John Stent. We have no personal knowledge of Mr. Stent, but he himself tells us that he is 'no expert in electrical science;' and he might have added 'English composition, or the history and merits of gas and oil lighting.' A perusal of Mr. Stent's little book leaves us in doubt as to the relative positions of gas, oil, and candles in the history of artificial lighting, and whether or not a joke is meant when we are told that the electric light is 'more certain than the sun.' A large portion of Mr. Stent's work is devoted to a comparison of the effects of gas, oil, and electric light on the atmosphere of our dwelling rooms, on the assumption that those rooms are hermetically sealed; but when he adds to the accident list of coal gas that of 'explosions in mines,' we are inclined to think that Mr. Stent has been betrayed by his enthusiasm. It seems to us a pity that Mr. Stent does not fully appreciate the meaning of his own words when he says: 'Every detail must be conducted with mathematical precision, and this takes the whole matter out of the range of ordinary thinking.'"

Direct Electric Welding.—Prof. Elihu Thomson has invented a method of electric welding which he terms "direct." Many persons may thus labour under the impression that this means the substitution of continuous for alternating currents, which have hitherto been used, but this is not the case. Prof. Thomson has simply designed and patented a combination welding apparatus and dynamo; in other words, the whole apparatus is self-contained, and no longer dependent upon an external source of electrical energy.

The Shilling Rate.—The report which has been issued by the Anglo-American Telegraph Company is no better, says *Money*, than that of the Direct United States, to which we referred in our last issue. We predicted when the 6d. tariff was inaugurated that it would not pay, and the result has justified the view we took. Sir John Pender, speaking at the meeting of the Direct Company, said that the rate is to be shortly raised to 1s. per word. This is not before time. Had it been adopted twelve months ago it would have been better for the companies forming the "Pool," and the shareholders as well. One per cent. on the ordinary and 2 per cent. on the preferred, which are the dividends declared by the Anglo Company, is not a grand distribution. Let us hope that the working of the shilling rate will be attended with better results.

Knocked Out.—We clip the following note from our American namesake:—"Forty arc lights were extinguished in St. Louis, on the night of the 4th instant, by a sky rocket which broke the wire in its upward flight. Another pointer for the underground workers."

A Pacific Ocean Cable.—Probabilities, says the New York *Electrical Review*, point to a new cable line across the Pacific. Mr. Matthew H. Gray, a well-known engineer, has recently spent some time in Chicago with his friend, Dr. G. R. Ghiselin, and is quite enthusiastic on the subject. Mr. Gray is the representative of the Silvertown Submarine Cable Company of London, and it now seems certain that the cable will be laid. It will run from Vancouver to some Australian port, and cost from three to four millions of pounds sterling—$15,000,000 to $20,000,000. The Canadian Government is interested, and a boom has sprouted in Vancouver property in anticipation of the happy results foreshadowed.

Personal.—Messrs. Chamberlain and Hookham have appointed Mr. Norman T. Gray engineer to the Birmingham Central Station Electric Light and Power Scheme. Mr. Gray was educated as a civil and mechanical engineer under his uncle, Mr. J. W. Gray, the engineer to the Birmingham Corporation Waterworks.

Electro-Medical Quackery.—A friend writes to us:—"You will observe from the enclosed cutting that your esteemed contemporary, the *English Mechanic*, is not above inserting the advertisements of the 'Eminent Consulting Medical Electrician.' Considering the position of the journal in question, and, to judge from some of the correspondence it publishes, the extreme ignorance of some of its subscribers, this seems to be a great pity." We notice that the extract sent to us is at the end of "answers to correspondents." It bears the form of an advertisement certainly, but is it not possible that the editor of our contemporary may have inserted the matter gratuitously for the benefit of suffering humanity?

The Underground Railway.—The *St. James's Gazette* thinks that the long-looked for improvement of the atmosphere of the Underground Railway seems at last to be within measurable distance. According to a statement made by Sir E. Watkin at the meeting of the Metropolitan Railway, a locomotive engine to be worked by electricity is in process of construction. Every traveller by the railway, remarks our contemporary, will await with interest the result of the experiment, which, however, if it succeeds, will not quite remedy existing evils. Locomotives worked by electricity will not relieve the sense of suffocation experienced in a carriage crammed with more passengers than it was made to hold. The overcrowding on the underground lines is constant and excessive.

The chairman of the Metropolitan Railway Company, Sir Edward Watkin, addressing the meeting of his shareholders last week, made the following reference to the electrical project. He said a locomotive engine was being constructed to be worked by electricity, and when it was completed it would be tried on the northern, or country, part of their railway. If it complied with all their conditions—and the experiments were to be at the cost of the Electric Traction Company—they would try and substitute it for the old-fashioned engine, and they would then have a locomotive which would make no smoke and give no trouble as to ventilation. Mr. Richardson, the chairman of the North Metropolitan Tramways Company, had spoken highly of the motive power of the Electric Traction Company; and he (the speaker) had been informed that Mr. Richardson's remarks had been practically used—but, of course, not officially—by General Hutchinson, of the Board of Trade.

Inventors' Institute.—The Inventors' Institute paid a visit on Saturday to Henley-on-Thames to inspect the Town Sewage Works on the hydropneumatic system of Mr. Isaac Shone, C.E. After steaming down the river to Clifden and Taplow, a visit was made on the return to Paddington to the Great Western electric lighting station, under the guidance of Mr. Spagnoletti. The plant regularly works on the alternating current system 4,000 incandescent and 100 arc lights. In practice the electric lighting has terminated the very frequent accidents which formerly occurred to the shunters and goodsmen and also a large amount of damage to the company's trucks and rolling stock, everything being now accomplished at night with as much precision as in the daytime.

NEW COMPANIES REGISTERED.

Crompton and Company, Limited.—Capital £140,000, in £5 shares. Objects: To acquire the business, goodwill, machinery, rights, privileges and other property of Messrs. R. E. Crompton & Co., and to generate, produce, store and distribute electricity for lighting, heating, or as a motive agent. Signatories (with 1 share each), Viscount Torrington, Maidstone; Sir Charles Grant, K.C.S.I., 5, Hyde Park Place; F. T. Medcalf, 4, St. Mary Axe; J. F. Albright, Chelmsford; R. E. Bell Crompton, 23, Porchester Gardens, W.; H.

Sherley Price, 52, Queen Victoria Street; C. T. Botwright, 23, Sutton Place, Hackney. The signatories are to appoint the first directors. Qualification, £500 in shares. Remuneration, £1,000 per annum. Registered 30th ult. by Messrs. Ashurst, Morris, Crisp & Co., 6, Old Jewry, E.C.

Monte Video Telephone Company, Limited.—Capital £180,000, in £5 shares. Objects: To carry on the business of a telephone company in all branches. Signatories (with 1 share each), F. A. Christie, 4, Albion Villas, Stoke Newington; J. B. Munro, 35, Linton Street, N.; H. C. H. Gibbs, 2, Abbeville Road, South Bank; R. Matthews, 54, Wharton Road, West Kensington Park; G. Jackson, 34, Gloucester Road, Holloway; D. R. Crane, 3, Erlam Road, S.E.; H. R. Clifton, 2, Shanklin Road, Crouch End. The signatories are to appoint the first directors. Qualification, £250 in shares or stock. Remuneration, £150 per annum each, with an additional £50 for the chairman. Mr. Edward Fauvel Powers is appointed managing director for two years, at a salary of £500 per annum. Registered 31st ult. by Messrs. Francis and Johnson, 5, Austin Friars.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Eagle Iron and Engineering Company, Limited.—An agreement of 16th inst. provides for the purchase of the business carried on by Mr. C. J. Bell under style of the Eagle Ironworks Company at Bond Street, Coventry. The purchase consideration is £4,000.

Chelsea Electricity Supply Company, Limited.—At an extraordinary meeting of this company held on June 27th at 12, Draycott Place, Chelsea, the following special resolution was passed and was confirmed at a meeting held at the same place on the 12th ult.:—"That the articles now before the meeting be adopted as the articles of association of the company in lieu of those at present in use as such." The resolution was duly filed on the 25th ult. Under these articles the directors' qualification is fixed at 10 shares, and the remuneration of the board at £1,000 per annum. The directors are Lord Thurlow, John Irving Courtenay, Nugent Daniell, Sir George R. Prescott, Bart., and Major-General Charles Edmund Webber, C.B.

British Association of Medical Electricians.—The following is a copy of the register of directors and managers of this company filed at Somerset House on the 27th ult.:—C. B. Harness, Heathside, Potter's Bar, consulting medical electrician, president; Dr. C. Lempriere, D.C.L., St. John's College, Oxford, vice-president; C. B. Hollier, Oak View, Streatham, consulting electrician; J. Hodges, 16, Great Ormond Street, W.C., medical electrician; Dr. R. C. Moffat, Northumberland Park, N., Professor of Chemistry; signed by H. C. R. Sharman, secretary.

Exeter Electric Light Company, Limited.—The statutory return of this company made up to June 21st was filed on the 26th ult. The nominal capital is £20,000 in £10 shares. 404 shares have been taken up and £2 per share has been called. The calls paid amount to £498 and unpaid to £310. Registered office, 16, Cathedral Yard, Exeter.

Cadogan Electric Light Company, Limited.—The registered office of this company is now situate at 91, Manor Street, King's Road, Chelsea.

Platinum Plating Company, Limited.—The statutory return of this company made up to February 27th was filed on June 16th. The nominal capital is £75,000 divided into 15,000 preference, 59,100 ordinary, and 900 founders' shares of £1 each. 15,459 shares have been taken up, 9,400 of which have been issued as fully paid. Upon 6,059 shares the sum of 5s. per share has been called. The calls paid amount to £1,113 7s. and unpaid to £401 8s. Registered office, 27, Clement's Lane.

LEGAL.

D'Arcy v. Liverpool Electric Supply Company.—(Before Vice-Chancellor Bristowe, Chancery of Lancashire, July 27th.)—This was an action brought by a licensed victualler, in Highfield Street, Liverpool, to obtain an injunction restraining the defendant company from working their electric supply machinery in such a manner as to be injurious to the health and business of the plaintiff. At the rear of the plaintiff's premises the defendant company had erected and are working an electric supply station. The plaintiff alleged that in consequence of the noise and vibration caused by the electric machinery his business had materially suffered; that the quality of the beer and other drinks stored in his house was deteriorated; that customers had left the house, and the health of himself and family had been injuriously affected. The plaintiff also apprehended that the nuisance would be increased as the company extended their supply to theatres and other buildings at night, which would necessitate the machinery working both night and day, they having at present no storage accommodation. Mr. Rotch stated that if the supply was continued at night the company would construct an accumulator in which to store the electricity, and there would be no necessity to work the engines throughout the night. On behalf of the defendants it was denied that there was any such inconvenience to the plaintiff and his house as to entitle the court to grant an injunction. The company, it was proved, had entered into an agreement with the landlord of the house to put up certain buildings in connection with their supply station; but, in reply to this, counsel for the plaintiff submitted that it merely compensated the landlord for obstruction of lights, and that it was no settlement of the tenant's right in respect of the nuisance complained of. After a lengthy hearing, his Honour said he would view the premises, and reserve his judgment.

CITY NOTES, REPORTS, MEETINGS, &c.

Submarine Telegraph Company, Limited.

The half-yearly meeting of the shareholders of this company was held at the offices, 2, Throgmorton Avenue, London Wall, on Tuesday, Sir Julian Goldsmid, Bart., M.P., presiding.

Mr. S. M. Clare, the secretary, having read the notice convening the meeting, and other formal business having been transacted,

The Chairman moved the adoption of the following report:—"The joint earnings of the two companies for the six months ending 30th June, 1888, amounted to £67,397 18s. 9d., and the working expenses to £27,788 1s. 9¼d. The joint earnings are £2,663 10s. 8d. more, and the working expenses £521 4s. 5¼d. less than the corresponding period of 1887. The result of the business for the half-year enables the directors to add, as usual, 15 per cent. of this company's proportion of the receipts to the reserve fund, to recommend a dividend at the rate of 13¼ per cent. per annum, and to carry a balance of £261 4s. 7d. to next account. The dividend paid for the half-year ending 30th June, 1887, was at the rate of 12 per cent. The number of messages transmitted in the six months ending 30th June, 1888, was 1,717,311, containing 19,073,919 words, against 1,618,634 messages in 1887, containing 17,901,009 words. All the company's cables, as well as those worked by the company, are in good working order. The company's steamer *Lady Carmichael* has been thoroughly overhauled in the course of the half-year at a cost of £907 14s. 9d., of which £500 has been charged in the annexed accounts, and the balance will be charged against the revenue of next half-year. The steamer is now in excellent condition, both as to her hull and general machinery, and has been surveyed by Lloyd's surveyors, who have classified her as 90 A1., *i.e.*, as a vessel of the first class. The negotiations between Her Majesty's Government and the board, referred to in the last report, have been continued during the half-year, and are now on the point of completion. As soon as an agreement has been finally arrived at the directors will forthwith lay it before the proprietors for their approval." This report having been taken as read, the Chairman said in former years he had told them, when there was a complaint of the diminution of the number of words in the messages, that he thought they must come to a termination of that reduction before long, and when he had been asked to fix the figure at which it would terminate he had said that he could not imagine that it would go below 11·0. It had, however, gone slightly below 11·0 on one or two occasions. With regard to the concession, they all knew that it would terminate very shortly. He had mentioned on previous occasions that not so very long ago they had great hopes that the concession given them by the French Government would be renewed, and had it not been that a very strong opinion was entertained by the English Government he believed that would have been the case; but, like sensible men, a decision having been come to, the directors had thought it was in the interests of the shareholders of the company to make the best of it. Ever since, therefore, they had been in active communication with the English and French Governments upon the subject of taking over the property of the company at the termination of the concession. On the last occasion Mr. H. Brand, who then presided, told them that the negotiations were progressing, and although they had come to an arrangement with regard to several points raised, there were still some which depended partly on the English Government, and partly on the French Government, which had still to be settled. Consequently, he was not in a position to state the absolute result of their negotiations. The shareholders had always reposed the greatest confidence in the board, and he assured them that he and his co-directors were doing their very best in the interests of the company. It would be gratifying to them to know that they had maintained their cables and ships, and, in fact, all the property connected with their business, in the very best possible condition, and he believed there was no telegraph company in the world that had a better plant or machinery than they had.

The Hon. Ashley Ponsonby seconded the motion, which was unanimously agreed to.

The retiring directors, the Hon. Ashley Ponsonby and the Hon. H. Brand, and the auditors having been duly elected, a vote of thanks was passed to the chairman and directors.

Globe Telegraph and Trust Company, Limited.

The fifteenth ordinary general meeting of this company was held on Friday at Winchester House, Old Broad Street, E.C., Sir John Pender, chairman, presiding.

The Chairman moved the adoption of the report (published in our last issue) and the payment of a dividend of 3s. per share on the preference shares and of 3s. per share on the ordinary shares, making, with previous payments, a total dividend for the year of 6 per cent. on the preference shares and of 3½ per cent. on the ordinary shares. He said that when he had last the pleasure of addressing them the prospects were not bright and the surroundings were rather gloomy. The Atlantic systems were working at a low rate; the Eastern Extension systems, with which they were largely interested, were just feeling the effects of the reduction that had been made at the Berlin Conference. The shareholders were then paid the lowest dividend that the company had ever paid. To-day he was glad to say things looked brighter. They had in a great measure recouped what they they were alleged to have sacrificed at the Berlin Conference, and they had, moreover, a prospect of seeing increased rates upon their Atlantic systems. The prospects of the other investments were also encouraging. Their Eastern system was doing well; their South African system, of which the Eastern Company were the principal proprietors, was doing remarkably well; as, also, was the Eastern Extension Company. In all these companies they were interested in a large degree. They were also interested in the Western Brazilian system, which was now emerging from a depressing condition, and was taking up a worthy position among the great telegraphic systems. Therefore the prospects were very much brighter than when he last had the pleasure of addressing them. The first question which more immediately interested them was the dividend, and it was so far satisfactory that they were paying £3 10s. this year as against £2 7s. 6d. last year. Taking their dividends from the beginning—extending over a period of fifteen years—while always paying their preference dividend, their highest ordinary dividend had been 5½ per cent. and their lowest ordinary dividend, which was paid last year was 2⅜ per cent. Averaging these dividends they were 6 per cent. on preference shares and £4 4s. on ordinary shares, or, taken together on their combined shares, an average dividend of £5 2s. 4d., say 5⅛ per cent. This was a point of interest as showing that the system of average which the company set up for telegraph stock and shares had been wholly successful, and that while the shareholder who bought in his Anglo-American property at par had reason to be grateful, the person who bought in his Indian and African shares had no reason to regret it, because his position was made secure. If they took the last four years they would find that the Eastern Company had contributed in 1885, £52,000 to £53,000; in 1886, £53,000; in 1887, £48,448; in 1888, £52,000. 1887 was the period when they worked at reduced rates imposed upon them at Berlin. The Extension Company at the same dates contributed: 1885, £39,176; 1886, £39,176; 1887, £33,000; 1888, £36,000. This had enabled them to maintain the dividend on their ordinary shares. During the last two years, however, the Anglo-American Company had been paying next to no dividend, and as their investment was very much in that company, it very materially affected the dividend of the Globe Company. But it was probable that their position would be improved by the revision of rates, and if the shilling rate, which would be put in force about the 1st of September, maintained anything like the increased traffic brought about by the sixpenny rate, very considerable benefit would accrue to the company. He might mention that every additional 1 per cent. paid on the Anglo stock meant 1s. 6d., or ¾ per cent., for every share on the ordinary shares of the Globe Company. If, therefore, the Anglo Company paid next year what they expected it would pay, it practically gave to the Globe Company a 1 per cent. additional dividend. This was on the understanding that all the companies would be in precisely the same position as they were to-day, but he hoped that there would be progress, and he looked forward to the time when they would resume something like respectable dividends. Since he had the pleasure of addressing them last the German Government had taken over the German Union cable, and the Globe Company, having a large interest in that concern, were now about to be paid off at a considerable premium. With a good investment he hoped that they would not get a smaller interest upon that particular portion of the capital in the future than they had been obtaining in the past. The general aspect at the present moment of submarine telegraphy was favourable. The war of rates was a disastrous war. Men like Mackay and Bennett, who knew little about telegraphs, thought that they were going to be national benefactors. It did not, however, require a very long time to convince them that it was not a very profitable business to be engaged in. That was being realised now, and as it took a considerable time to bring about combinations after men had suffered, he thought that they were very likely to have a quieter time in the submarine system generally, and that during that quiet time they would have an amount of progress in their traffic which would materially tell upon the Globe.

The Marquis of Tweeddale seconded the motion.

Dr. Griffiths, a barrister, who said that he came in no unkindly spirit, asked whether the Marquis of Tweeddale, one of the retiring directors, had attended a single meeting of the board last year?

The Chairman: I am not aware that the Marquis of Tweeddale has been absent from one meeting.

Dr. Griffiths thought that a little fresh blood was wanted on the board. That was a question he did not propose to discuss, but he wanted to know the object of a trust like this. He bought at 26¾ a property which was worth to-day 16 or 17. Surely there could be no object in creating a trust like this unless they controlled the market. As to the tariff war, unless it could be prevented by the trust, there was no reason for the trust existing.

Mr. Wetherby called attention to the expenditure, which he thought was not necessary in conducting the business. Why should they have a board of directors if they did not sustain the prosperity of the company? The previous speaker was correct in saying that the property was continually depreciating. Was it necessary that they should have such an expensive staff and such an expensive board of directors? Why not get an amendment in the articles of association by which the large sum of money that went into other pockets should be paid to the shareholders? He moved as an amendment that the report of the directors be not received.

Mr. Jackson remarked on the pluralism of the directors, who did not confine their attention to one business, and said that nothing but disaster would result if this were to continue.

The Chairman, in answer to Mr. Wetherby, said that the business of the company was being conducted in a way that was satisfactory to the majority of the shareholders. The capital was over three millions sterling, and the expenses were proportionately lower than any other company. With regard to a remark that the enterprise was hindered by jealousy among the directors he might say that if perfect harmony had not existed among them the submarine system, which was the admiration of the world, would never have been in the position it now was.

The motion was carried unanimously.

The retiring directors and the auditors having been re-elected the proceedings terminated.

The Northern District Telephone Company, Limited.

At the sixth annual meeting of the above company, held at the offices, Arcade Chambers, Sunderland, Mr. R. T. Wilkinson presiding, the following report of the directors was read for the year ending 31st of December, 1887:—

The capital expenditure for the year has been £14,657 15s. 2d., which, added to previous amount of £31,854 5s. 6d., shows a total of £46,512 0s. 8d. expended in the company's district. The revenue accounts show that the receipts of the company from all sources, attributable to the year, have been £6,585 16s. 1d., as against £4,277 7s. 10d. for 1886, or an increase of £2,308 8s. 3d.; and the expenditure has been £2,858 14s. 1d., as against £2,041 10s. 9d. for 1886, an increase of £817 3s. 4d. The company are continuing to make considerable progress in the development of their system. The number of subscribers to the exchanges have increased from 438 on 31st December, 1886 (representing a total rental of £4,114 3s.), to 562 subscribers on 31st December, 1887 (representing a total rental of £7,277 19s. 4d.). Exchanges have been opened at Blyth, Bishop Auckland and Seaham, and are now working satisfactorily. The company have now in all, 13 exchanges in full working order. Considerable additions have been made to the trunk wires, connecting the whole of the company's system together. The private line business of the company continues to increase, the rentals from this source being £1,430 15s. 1d. as against £1,237 8s. 4d. last year, and the directors still anticipate a very large increase during the present year. The company have 150 private lines erected in the various towns of their district, and the directors are glad to state that the use of the trunk wires between the various towns is very rapidly increasing, the amount received for occasional messages alone being £511 4s. 9d., as against £105 3s. 6d. for the year ending 31st December, 1886. The continued development of the company's business is further evinced by the fact that of the total amount of the rentals for the year 1887 (£7,817 12s. 9d.), the large proportion of £3,217 6s. 10d. is carried forward to 1888, against £2,038 0s. 2d. brought forward from 1886. The balance of net revenue as shown by the balance sheet is £2,392 5s. 11d., of which £2,333 14s. is absorbed by the payment of the dividend of 6 per cent. upon the paid-up preference capital, leaving a balance of £58 11s. 11d. carried forward. The progress of the business for the present year has, so far, been such as to lead the directors to hope that they may be able to recommend at their next annual meeting a dividend upon the ordinary shares of the company.

The Chairman, in moving the adoption of the report, congratulated the shareholders on the great progress made by the company during the past year, notwithstanding the strong competition of the Post Office. The increase in the revenue over 1886 amounted to £2,308 8s. 3d., and he was glad to say the current year would show a much better result. For the first six months of the present year the revenue from subscribers alone had increased by no less a sum than £1,674 13s. 7d. The large increase in the calls also proved that the public had appreciated the policy of the directors in reducing the charge for local calls to one penny, and in opening call offices where they found there was a demand. The charge made for conversations by this company was, he believed, at a less rate than any other telephone system in existence, but the public at large had not as yet realised the fact that for sixpence they could converse for three minutes with their friends between any of the following towns, namely, Sunderland, Newcastle, North or South Shields, Durham, Bishop Auckland, the Hartlepools, Stockton, Middlesbrough, Darlington, Blyth, or Seaham, whereby they could ask and receive a reply for half the price of the lowest charge for telegraphic communication, and for the sum of one penny they could speak to their friends or order their goods from their tradesmen. The local and trunk calls had increased 71 per cent. over the preceding year. He regretted to say that as regards Newcastle the company had not made the progress they expected, partly owing to the competition of the Post Office, also to other minor difficulties; but he was glad to be able to report that the United Telephone Company had at last obtained an agreement with the City Corporation for them, which would admit of the application of cheap rates of subscription and of the rapid erection of lines. The amount shown in the balance-sheet as being in suspense was so treated by permission of the United Company, who desired to have a legal decision concerning various items of the agreement with the district companies before calling upon them to admit the liability. The matter which arose in the case of the Lancashire Company had recently been arranged, and the similar items in the accounts would therefore now be settled probably with some concessions on the part of the United Company, who had always hitherto met them in a generous spirit, and with whom they had always been on the best of terms.

Mr. J. B. Morgan, managing director of the United Company, congratulated the meeting on the progress of the Northern Company, and promised to use his best endeavours to arrange all matters not yet settled between the company and the United Company. He then proceeded to explain the progress of the negotiations for the amalgamation of the different companies, and said that as soon as these were completed the district would be put in trunk communication with London, Liverpool, Bristol, South Wales, Birmingham, and the Midland districts on the south and west, and with Scotland on the north.

It was unanimously decided, after some discussion, to accept the principle of the amalgamation, leaving the details for further arrangement.

On the motion of the chairman, seconded by the vice-chairman, a dividend of 6 per cent. was declared on the preference shares.

Mr. R. M. Hudson, jun., was re-elected a director on the motion of the chairman, seconded by Mr. Morgan; and Mr. Smyrke was also re-elected auditor.

The meeting was then resolved into an extraordinary general meeting, and the following resolution was moved and carried:—

That the articles of association be altered as follows:—

(*a*) The following article shall be substituted for Article 67A, namely:—"They may borrow any sum or sums of money on such security and terms as to interest or otherwise as they may deem fit, and may secure the same by mortgage or other debentures, or by bonds or other securities, or by any mortgage or charge of or upon the whole or any part of any property, funds, assets, or effects of the company or its uncalled capital; but so that not more than £25,000 be owing at any time without the consent of a general meeting, and provided that no part of the said sum of £25,000 shall be borrowed without the consent of the United Telephone Company, Limited, and no borrowed money shall, without the like consent, carry interest at a higher rate than 6 per cent. per annum."

(*b*) In article 87, the word "and" coming after the word "agencies" shall be omitted, and the words "trunk lines and new business" shall be inserted after the word "branches." The clause as amended shall apply as from the formation of the company.

A vote of thanks to the chairman having been passed unanimously, the meeting terminated.

The National Telephone Company, Limited.

THE directors' report states that the capital expenditure for the year has been £43,854 8s. 6d., against £36,718 12s. 1d. in the previous year.

The gross revenue allocated to the past year is £99,119 2s. 2d., against £85,078 6s. 1d. allocated to the previous year, and the amount carried forward to next year is £58,495 18s. 4d., against £49,525 15s. 8d. carried forward last year.

The annual rentals on the 30th June reached £106,572 12s. 7d., against £90,537 2s. 4d. at the corresponding date of the previous year, showing an increase of £16,035 10s. 3d. There is also a revenue derived from fee messages, at the rate of £3,000 a year, against £1,800 last year, making the total gross revenue reached on the 30th June £109,572 12s. 7d., and giving an increase of £17,235 10s. 3d. over the total of last year.

After providing for the accrued interest on the debentures, the dividend of 6 per cent. on the first preference shares, the dividend of 6 per cent. on the amount of second preference capital paid up, and after having paid an interim dividend for the first half of the year at the rate of 4 per cent. per annum on the ordinary capital, there remains a balance of profit amounting to £17,003 5s. 1d. Out of this the directors propose to allot a further sum of £11,250 to the payment of a dividend upon the ordinary capital for the second half of the year, at the rate of 5 per cent. per annum, and besides placing £2,500 to the reserve fund, to carry forward £3,253 5s. 1d. Out of the amount carried forward a sum will be required towards the adjustment of long-standing claims between the United Telephone Company and this company, now in process of being satisfactorily settled by mutual concession.

The company has increased its trunk system, so that it has now 842 miles of trunk pole lines connecting towns with each other, carrying 2,509 miles of wire, against 643 miles of pole lines carrying 1,919 miles of wire at the same time last year.

The company has 117 telephonic exchanges with 8,056 lines. The lines of the private wire renters number 1,268, making the total number of exchange and private lines 9,324. The increase of exchanges is 26, and of exchange and private lines 1,470.

The Cuba Submarine Telegraph Company, Limited.

THE report of the directors for the half-year ending 30th June, 1888, states that the gross receipts (including the balance brought from last account) amount to £24,274 19s. 8d., and the gross expenditure (including the half of the annual payment on account of the 1881 cable, and the expenses in connection with cable repairs) to £6,879 2s. 3d., leaving a sum of £17,395 17s. 5d. to the credit of revenue account.

Of this the sum of £6,000 has been added to the reserve fund, increasing that fund to £80,000.

The dividend on the preference shares will absorb £3,000, and leave £8,395 17s. 5d., out of which the directors recommend the payment of a dividend on the ordinary shares at the rate of 9 per cent. per annum, free of income tax, the balance, £1,195 17s. 5d., being carried forward to the current half year's account.

The Batabano-Cienfuegos (original) cable broke down on 3rd February, and was repaired on 18th idem. This cable not being duplicated, messages were forwarded during the interruption over the landlines of the Government. All the cables are now in good working order.

South Eastern (Brush) Electric Light and Power Company, Limited.

AN extraordinary general meeting of this company was held on Monday at the Guildhall Tavern, Gresham Street, Mr. W. H. Pannell, F.C.A., the liquidator, in the chair, to consider resolutions—(1) for adopting the accounts and report presented by the liquidator (audited and approved by four of the principal shareholders) as to the manner in which the winding up had been conducted and the property of the company disposed of, and authorising the liquidator to distribute the balance of cash in hand as proposed in the accounts; (2) authorising the liquidator to destroy all books and papers of the company and of or relating to the liquidation at the expiration of three months; and (3) "That the liquidator do forthwith, in accordance with section 143 of the Companies Act, 1862, report to the Registrar of Joint Stock Companies that the affairs of this company are fully wound up, and that the final meeting has been held." When the company went into liquidation there was 6s. 6d. a share uncalled, and the liquidation had been closed with a call of 2s. 3d. a share. It was proposed to distribute 8s. 7d. a share on the 400 fully paid shares, and ½d. a share on the 17,654 ordinary shares. The total loss of the company had been £45,953. The liquidator formally proposed the resolutions *seriatim*.

Mr. Booker moved an amendment to the effect that the books should not be destroyed for a year, in order that the shareholders might have further opportunity afforded them for prosecuting the promoters, directors, and others.

The amendment was not seconded, and the resolutions were agreed to.

Provincial (Brush) Electric Light and Power Company, Limited.

UPON the termination of the meeting of the shareholders of the South-Eastern Brush Company, an extraordinary general meeting of the Provincial (Brush) Electric Light and Power Company was held, Mr. Pannell in the chair, to consider precisely similar resolutions. On the company going into liquidation there was an uncalled liability of 5s. a share, and the liquidator had managed to close affairs with a call of 2s. 6d. a share. The balance available for distribution by way of dividend, as return of capital, to the shareholders at the rate of 3½d. per share, was £248 19s. 9d. The total loss of capital had been £51,096. The resolutions having been proposed,

Mr. C. H. Stewart expressed his sympathy with the observations which Mr. Booker had made at the previous meeting, but said he felt that the liquidator had done the best he could for the shareholders. He considered that the inception and management of the two companies had been a stain on the commercial morality of the City. With regard to the Consolidated Company, neither the South-Eastern nor the Provincial Company had had anything to do with it except that both of them had been drawn upon for its benefit.

The resolutions were passed.

TRAFFIC RECEIPTS.

The Western and Brasilian Telegraph Company, Limited. The receipts for the week ending July 27th, 1888, after deducting the fifth of the gross receipts payable to the London Platino-Brasilian Telegraph Company, Limited, were £3,864.

The West India and Panama Telegraph Company, Limited. The estimated receipts for the half-month ended the 31st July are £2,806, as compared with £2,453 in the corresponding period of 1887. The April receipts, estimated at £6,290, realised £6,349.

The Brasilian Submarine Telegraph Company, Limited. The traffic receipts for the week ending July 27th amounted to £4,592.

NEW PATENTS—1888.

10194. "Improvements in electrical switches." A. C. Cockburn. Dated July 13.

10209. "An improved electric regulator." F. V. Maquaire. Dated July 13.

10220. "Means or apparatus for automatically establishing electrical contact for motion and light purposes on receipt of a coin in views or other boxes, said coin being freed at a fixed period following the motion." W. S. Simpson. Dated July 13.

10245. "Improvements in and connected with electrical safety cut-outs." E. Perrett. Dated July 14.

10265. "Life saving apparatus to be attached to tramway engines, or to cable or electric tramcars and other vehicles." T. Jenks. Dated July 16.

10299. "Improvements in electric logs." N. W. Wallace. (Communicated by Percy Scott, H.M.S. *Edinburgh*, Malta.) Dated July 16.

10345. "Improvements in electrogens or appliances for preventing corrosion in steam boilers." J. B. Hannay. Dated July 17.

10363. "Improvements in and relating to multiple telegraphy." E. J. P. Mercadier. Dated July 17.

10434. "Electric material for medical and curative purposes." T. Field, jun. Dated July 18.

10437. "Improvements in printing telegraphs." J. E. Wright and J. Moore. Dated July 18.

10472. "Improvements relating to coin-freed induction coils." F. A. E. Croker. Dated July 19.

10492. "Improvements in holders for incandescent electric lamps." C. S. Snell. Dated July 20.

10505. "Improvements in instantaneous make and brake electric switches." E. Rousseau. Dated July 20.

10524. "Improvements in electric railways." B. J. B. Mills. (Communicated by The Bentley-Knight Electric Railway Company, United States.) Dated July 20.

10568. "Improvements in the manufacture of electric bells." F. H. Royce. Dated July 21.

10572. "Controlling train lighting dynamos." J. H. Woodward, B. M. Drake, and J. M. Gorham. Dated July 21.

10584. "Improvements in and relating to switch boards or apparatus for connecting circuits and signalling in telephone exchange systems." F. R. Welles. Dated July 21.

10604. "Improvements in the elements for secondary batteries." I. A. Timmis. Dated July 21.

10631. "Improvements in electrical night-signalling apparatus." E. Kaselowsky. Dated July 23. (*Complete.*)

10654. "Improvements in electric arc lamps." W. R. Mortimer, J. Holloway. Dated July 23.

10666. "Switchback telegraph." H. Ridley, J. Skeldon. Dated July 24.

10690. "The automatic alternatable position flushing and draining in and out of action electric battery, and system for electric batteries." A. H. Gladwin. Dated July 24.

10691. "Improvements in or relating to electrical transmitting instruments." A. J. Boult. (Communicated by J. F. McLaughlin, United States.) Dated July 24.

10730. "Improvements in electric firing gear for guns." A. Noble. Dated July 24.

10766. "An improvement connected with arc lamps whereby the controlling mechanism is simplified for the purpose of adjusting the distance of the carbons and to facilitate the steadiness of the arc." J. Kent. Dated July 25.

10782. "An electric meter." H. W. Miller. Dated July 25.

10813. "Improvements in and relating to apparatus for receiving payment and administering electricity for medical or other purposes." W. J. Woodward. Dated July 26.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1886.

6646. "Apparatus for closing electric circuits." J. Enright. Dated May 18. 8d. The object of the invention is to provide means of closing electric circuits for definite periods at particular times for such purposes as opening a valve to deliver a supply of fluid, operating an alarm, &c. The claims are 11 in number.

6619. "Improvements in electric type printing instruments." O. Romanze. Dated May 17. 11d. Claims:—1. In electric type printing instruments the use in the receiving portion of a type or printing wheel having the letters or signs to be printed attached to or formed on the side of the wheel, as distinguished from the periphery or outer circumference. 2. In electric type printing machines the combination in the transmitting portion with a suitable motor of the keys with contact stems, the make and break path and the arms connected to the line, and thence to the receiving instrument, substantially as described. 3. In electric type printing machines the combination in the receiving portion thereof of a type or printing wheel with mechanism arranged so that it is rotated upon its axis relatively with the movement of the contact maker and breaker of the transmitting instrument and with mechanism, by which a printing movement is given to the said type or printing wheel at the proper time, substantially as described. 4. In electric type printing machines the combination with the type or printing wheel of the receiving portion thereof of means for moving the strip printed on the width of a type during each movement of the type from its printing position, substantially as described. 5. In electric type printing machines the combination, with the receiving portion thereof, of a snail groove or slot and controlling pin for truly adjusting the printing or type wheel to the transmitting portion, substantially as described. 6. The arrangement and combination of parts constituting the transmitting portion of an electric type printing machine, substantially as described and illustrated by the drawings. 7. The arrangement and combination of parts constituting the receiving portion of an electric type printing machine, substantially as described and illustrated in the drawings. 8. The arrangement and combination of parts constituting the electric type printing machine as a whole, substantially as described and illustrated in the drawings.

7251. "Improvements in the manufacture of carbon filaments or other conductors for incandescent electric lamps. W. Maxwell. Dated May 31. 6d. Claims:—1. The described process for depositing carbon on the conductors of incandescent electric lamps by electrically heating them in a vessel through which continuously flows a mixture of hydrocarbon vapour with a gas that does not chemically act upon the carbon. 2. In combination with the process stated in the preceding claim the described preliminary process for purifying the conductors by electrically heating them in a vessel through which continuously flows at reduced pressure a gas that does not chemically act upon the conductor.

7279. "A regulator for high tension electric currents." A. H. Byng. Dated May 31. 8d. The regulator is composed of a number of pieces of foil or thin sheet metal, preferably tin or zinc, placed upon or against a piece of wood or other suitable bad conductor, in a straight or other line, and with a space or interval between each foil or metallic piece and that next following. One of the wires from the battery is connected by a binding screw or otherwise to the foil or metallic piece at the one end of the regulator, and the other wire is connected to a spring clamp or other suitable device which can be moved upon the regulator so as to make contact with any one of the foils or metallic pieces. According to the position of this clamp—that is to say, according to the number of foils or metallic pieces between it and the other wire and to the space between these foils—so is the strength of the current regulated.

7405. "Improved arrangement for applying electro-motors to vehicles." M. Immisch. Dated June 2. 8d. Claim:—Suspending electro-motors to vehicles by means of a link attached to the underside of the body of the vehicle, and a sleeve or sleeves surrounding the axle of the driving wheel or wheels of such vehicle, substantially as and for the purpose specified.

1887.

7865. "Improvements in dynamo-electric and electro-dynamic machines." F. George. Dated May 31. 8d. The inventor constructs an open coil ring armature of one or more coils, the terminals of which he connects with the external circuit by means of sliding conductors or collectors, and he causes the armature to revolve in a magnetic field produced by one pole only, or by two or more poles of similar polarity (N. or S.) that by the continuous cutting or crossing in the same sense of the lines of magnetic force, a continuous current in the armature coils and consequently in the external circuit may be produced. The claims are 6 in number.

8500. "Improvements in conduits for electric wires or cables." R. S. Waring. Dated June 13. 8d. Claims:—1. In a conduit for electric wires or cables, the combination of one or more compartments open at the top of the conduit for the reception of a large number of wires or cables and a series of cellular compartments or passages for the drawing in of additional wires or cables, as set forth. 2. The combination of conduits for electric wires or cables provided with a series of longitudinal passages and a turning box or block provided with a series of curved grooves or passages, as set forth. 3. A conduit for electric wires or cables having in combination an open sided box or trough, the sides of said box being grooved as described and a removable cover therefor, said cover being composed of two or more parts united by a tongue and groove joint, the outer edges of the cover being provided with tongues adapted to fit within the grooves in the sides of the box, as set forth. 4. In a system of underground conduits for electric wires or cables, the combination of conduits and man-holes constructed as described.

13601. "Improvements in 'automatic' coin-freed electrical machines and in the method of displaying advertisements therein." J. H. Davies and A. Thompson. Dated October 7. 11d. This invention relates to improvements in "automatic" coin-freed electrical machines, and to improvements in the method of displaying advertisements in "automatic" machines generally; the object being to provide means whereby the electric current may be caused to start, on the machine being brought into operation, from zero and gradually increased in strength, with a time limit to its duration; to protect the machine against fraudulent use; and to automatically display advertisements when the machine is brought into operation. The claims are 10 in number.

CORRESPONDENCE.

Electrical Workman's Club.

I notice you report that steps are being taken to formulate an electrical workman's club. I am an electrical workman myself, and interested accordingly; but I fail to understand how it will be of much benefit to its members or effect any reforms in the "trade," since it is hopeless to expect that contractors and employers of labour will recognise its rules and regulations, as I believe it is intended they should. For installation work they will still continue to employ all sorts and conditions of men as may best seem to suit their purpose; although two blacks don't make one white, nor a bargeman and a greengrocer one electrician, yet so long as they can distinguish the difference between a piece of covered wire and a haystack they are mostly sufficiently so, and are far more likely to find employment as such at 20s. a week each than one skilled and competent at £2. The old adage that "the weakest, &c.," and the survival of the fittest will not hold good in this particular industry at the present day, and as much of the work is done in an unscientific manner, science and skill are unnecessary attainments, and a carpenter, bricklayer, or other tradesman who combines his own with electrical work, is and will be an effectual bar to the man who tries to make it his sole profession, and although possessed of superior ability in the special branch, finds himself driven to the wall. If the club can prevent such from ultimately becoming a burden upon the poor rates, they will have done something; but whether they can muster sufficient strength among themselves I very much doubt. It is anything but a cheerful outlook to those engaged, and more especially for those disengaged, and to those who are thinking of adopting it as a profession. From my own experience, I should advise them to consider *Punch's* advice to those about to marry.

H. Raison.

Electropathic Quackery.

We make the following suggestion: To reprint the correspondence which has appeared in your paper bearing on the above-named subject, and the extremely amusing and ingenious skit reprinted by you from the *Cornishman* in this week's issue, in the *Daily Telegraph*, with a big bold heading. We think that this would have the effect of completely overthrowing this electropathic quackery. *Sic transit gloria mundi.*

L. S. M. P. and H. T. B.

P.S.—We, no doubt, among many others, should be willing to contribute our mite, should a subscription be opened for this purpose.

[Our correspondents apparently are unaware that their suggestion has already been proposed, and that a subscription list, with Mr. Jerritt as secretary to the fund, has already been opened.—Eds. Elec. Rev.]

Some years ago a man was brought before the Lord Mayor charged with obtaining money by false pretences. This individual had been advertising a sewing machine for one shilling. Hundreds of ladies nibbled at the bait and parted with their money. When this "sewing" machine was examined it turned out to be a simple clip for fastening the work to the table while the sewing was done in the ordinary way with a needle and a reel of cotton. This "clever" swindler was sent to prison as a common felon, and justice was satisfied. Now, I want to know the legal difference between the man who sells a bogus machine worth twopence for a shilling and the individual who sells a bogus electrical appliance value three shillings, for three and five guineas?

The plucky course you are now taking entitles you to the gratitude of the public, for you are, slowly, but surely, ringing the death knell of the greatest fraud of the day.

In conclusion, I should like to know if the proprietors of the leading daily journals know anything of the class of goods so extensively advertised in their columns.

W. Field.

Comparing Very Unequal Capacities.

The thanks of your readers are due to Profs. Ayrton and Perry for having contributed the valuable extract from their publications upon this subject.

I observe that three methods are given, in two of which the initial charge in the larger condenser is gradually diminished, and in the third the charge in the larger condenser is gradually increased.

I also observe that in the second method two distinct operations are acting to diminish the initial charge in the larger condenser, A, and this is plainly shown in the algebraical operations. First, the charge in the larger condenser is diminished by a constant quantity equal to $k\,e$, and second, the resultant charge is shared between both condensers, so that the total quantity by which the initial charge is diminished at the first operation, say, is $k\,e + \frac{(K\,E - k\,e)\,k}{K + k}$, for the charge $\frac{(K\,E - k\,e)\,k}{K + k}$ in B must be neutralised before it can be again charged to the P.D. $= -e$. But, whilst I have no difficulty in following the reasoning applied for the elucidation of the formula in this and the preceding method, I am unable to understand the algebraical operations by which the same formula is evolved for the third method. After charging K to P.D., E, the charge is shared with the uncharged condenser, k, which has a much greater capacity, and the resultant P.D. is given as $e = \frac{E\,K}{K + k}$.

"*Therefore* after n connections of the small condenser with the larger the resultant difference of potential between the coatings of either will be

$$E\left(\frac{K}{K + k}\right)^n.$$

It appears to me that the P.D. of the combined condensers must increase more quickly than this equation indicates.

Suppose K to be charged a second time to a P.D. $= E$ as before, and to be again connected to the larger condenser, and let the resultant P.D. be e_2.

Before being connected to K for the second time, k already has a charge $= e\,k$. Consequently the total charge in the combined condensers is now

$$E\,K + e\,k$$

and this is equal to $e_2\,(K + k) \quad \therefore \quad e_2\,(K + k) = E\,K + e\,k.$

But $$e = \frac{E\,K}{K + k} \quad \therefore e_2\,(K + k) = E\,K + \frac{E\,K\,k}{K + k}$$

from which $$e_2 = E\,\frac{(K^2 + 2\,K\,k)}{(K + k)^2}.$$

The charge in k is now $e_3 . k$, and on repeating the above operation we get a fresh P.D.

$$e_3 = \mathrm{E}\,\frac{(\mathrm{K}^3 + 3\,\mathrm{K}^2\,k + 3\,\mathrm{K}\,k^2)}{(\mathrm{K} + k)^3}.$$

Similarly for the fourth operation

$$e_4 = \mathrm{E}\,\frac{(\mathrm{K}^4 + 4\,\mathrm{K}^3\,k + 6\,\mathrm{K}^2\,k^2 + 4\,\mathrm{K}\,k^3)}{(\mathrm{K} + k)^4}$$

From these equations we can see that for the *n*th operation we get

$$e_n = \frac{\mathrm{K}^n + n\,\mathrm{K}^{n-1}\,k + \dfrac{n\,(n-1)\,(n-2)}{1 \cdot 2}\,\mathrm{K}^{n-2}k^2 + \ldots\ldots\ldots\ldots \dfrac{+\,n\,(n-1)\,(n-2)\,\ldots\ldots\,\{n-(n-2)\}\;\mathrm{K}\,k^{n-1}}{\underline{|n-1}}}{(\mathrm{K} + k)^n}$$

Reducing the right-hand fraction to its lowest terms and transposing we get

$$\frac{\mathrm{E}}{e_n} = 1 + \frac{k^n}{\mathrm{K}^n} \text{ approximately.}$$

Perhaps some one will kindly point out where I have committed on error, as this result certainly does not coincide with that given by Profs. Ayrton and Perry. In conclusion, I may point out that Dr. Fison's arrangement, giving as it does a null method of comparing very unequal capacities, is an additional advantage to those enumerated by Profs. Ayrton and Perry.

J. Pigg.

July 24th, 1888.

High Potential Dynamos.

I noticed in a recent leaderette some remarks regarding high potential dynamos with Gramme collectors, followed by a letter from Mr. Eaves on the same subject, in your issue of last week. There is no difficulty in constructing the class of dynamo referred to, and Messrs. Paterson and Cooper, who have given considerable attention to arc lighting, are constantly sending out machines of potentials from 600 to 1,100 volts. The notion that high potential machines cannot be made with Gramme collectors probably arises from the fact that a machine of higher potential than 1,000 volts is seldom asked for. If a client wishes to run 40 arc lamps, it is preferable for many reasons to run them from two 20-light dynamos than from one 40-lighter; while for larger installations, where more dynamos are required, the 20-light machine is a very convenient unit size. But it must not be thought that dynamos of higher potential—say, up to 2,500 volts—cannot be constructed if necessary. We are quite prepared to make any number of such machines.

It seems unlikely that the development of continuous current transformers will bring potentials higher than 1,000 volts into use. It is well known that the gain in economy of conductors by the use of still higher potentials, after a certain point has been reached, is but trifling, a fact strongly emphasised by Mr. Crompton in his recent paper on distribution. Hence a demand for increased potential need hardly be expected from this quarter.

If there are 80 bars in the collector of an 800 volt machine, the mean difference of potential between the bars is 20 volts, not 10, as Mr. Eaves has it. The potential between the bars is, however, only one of the many points which require consideration in designing arc machines.

In conclusion, it may be mentioned that a Phœnix machine of 1,150 volts is working nightly at the depôt of Messrs. Crisp & Co., Holloway, supplying current for 21 Pilsen arc lamps. This machine has 72 sections in its collector, or about 32 volts mean potential between the bars and works without a spark at the brushes.

W. B. Esson.

July 30th, 1888.

Amateur Central Stations.

Wading through the *Telegraph* to-day I saw an advertisement which has taken my attention, and I think your readers will think it a standing disgrace to the electrical profession in general. It is from a well-known school of telegraphy (advertisement enclosed), and points out that the proprietors are laying down an important public central station, the whole of the working of which is to be carried out and maintained by "students."

Does it not suggest itself to the members of the trade that it is classing electric lighting very low, when we come to consider that several stations are running satisfactorily only through the combined energy of learned and well-known electricians and thoroughly practical wiremen, all of whom are paid well for knowledge which has been gained only by years of arduous toil and study?

Can it be, therefore, supposed that a few teachers can do the whole of this work with the aid of pupils alone?

Can nothing be done to avoid so great an industry being ruined by, to say the least, unprincipled proposals?

Supposing the work is to be carried out, can anything but disappointment follow?

Shopkeepers, &c., will no doubt rush wildly at the chance of having their power from this station, to be eventually deceived, and from thence become enemies to electric lighting.

I hope that somebody more skilled in the art of penmanship than myself will take up this subject, and endeavour to persuade people who would act thus to exercise discretion for the sake of the profession in general.

Wallace J. L. Sandy.

July 30th, 1888.

[We do not think that the "bogey" of which our correspondent has such a dread will affect the general question of electric lighting in the slightest degree. If people choose to adopt electric lighting laid on from a station which, as the writer seems to think, possesses facilities for frequent extinctions, it is their own look out, for the advertisement states very plainly the manner in which the installation is to be carried out and maintained (?)—EDS. ELEC. REV.]

Telegraph Survey and Construction.

I was glad to learn from the REVIEW of 27th inst. that Mr. John Neale, Telegraph Superintendent and Engineer of N. S. Railway, disclaimed authorship of the letter on the above subject in the REVIEW of May 25th last. Had that gentleman at the same time told us who his namesake was and what position he holds in his company's service, it would have been interesting and form a guide to your correspondents in replying to letters of a similar nature. I need hardly remind you that my time is too valuable to be wasted in answering communications on this important subject from parties holding subordinate positions and who are minus a reasonable knowledge of the subject on which they venture to write.

Arthur E. Gilbert.

Highland Railway, Inverness,
July 30th, 1888.

When Mr. Gilbert's article on this subject appeared in the REVIEW of 18th May, I hoped to see it followed up by details of the systems employed on other lines, as a comparison of the various systems would, I feel sure, have been of great service to inspectors, foremen and others, who, like myself, take some interest in matters of the kind, although in Mr. Gilbert's opinion only "capable of receiving the necessary instructions, and of being left in charge of the construction work after the engineer's personal survey."

None of the railway engineers have taken any notice of the article so far, and it is to be feared that the pronounced and somewhat coercive tone (I have heard it called by another name) of Mr. Gilbert's letter of 14th inst. has put the possibility of notice now quite out of view. Personally, I regret this, as the pleasure and profit I hoped to receive from a free discussion of the subject can scarcely now be looked forward to. If, however, it is not too late, I would like to draw attention to one or two points in the system propounded by Mr. Gilbert, and to ask for further information concerning it.

In the first place, it is observed that the span of the line between Dava and Grantown is fixed at 60 yards, while in the letter of 14th inst. it is declared that "for a line of telegraph, no matter how few the wires, 88 yards is excessive; and for a heavy or exposed line 60 to 70 yards, on straights and easy curves, and down to 55 or even 50 yards on heavy curves, is ample for safety." Well, I don't dispute the statement, as my object is not so much to defend any particular length of span, as to obtain proofs, if possible, of the necessity for the short span employed in Mr. Gilbert's system.

It is a very apparent fact that the shorter the span, the greater the stability and safety must be; but it is not so clear why some engineers are satisfied with a span of 90 yards or so, while others run down to 30 or even 40 yards less than this. If, as stated by Mr. Gilbert, 60 yards is "ample for safety," 90 yards must be unsafe or, at least, risky. The sooner then this is made clear the better; but as the "length of span" is not a matter which any engineer would decide by rule of thumb (assumption and observation only), Mr. Gilbert should not so emphatically declare the necessity for a particular length of span without furnishing calculations to prove it.

If he gives—

The minimum breaking strain (approximately) of average poles, single and double, without and with various sized stays fixed in different positions.

Strain of each No. 7½ and No. 10½ iron and No. 14 copper wire on poles carrying wires on angles of, say 1 up to 20 feet, with 60 yard spans.

Estimated bulk and weight per yard of heaviest coating of snow observed on wires.

Pressure per yard of heaviest wind broadside on heaviest snow-coated wire.

The figures can be compared with calculations made by other engineers, and if not sufficient to convince 90-yard engineers of the error of their ways, will at least be interesting, and possibly useful to many of your readers.

Mr. Gilbert might also say how levels are obtained where poles are placed on ground more than 14 feet (the length of his levelling stick) above or below the railway.

What would the average cost per mile of such a survey be? Would it not in the case of light lines represent about 30 per cent. of the total labour cost of construction? Two miles per day is not much ground to get over (light lines cannot be got over more quickly than heavy ones), and the wages and expenses of an engineer and six men run up a solid total even daily.

It may be pointed out here that—

"Pegging the section

Surveyor	1
Construction foreman	1
Stick carriers	4
Pegdrawer and holemaker ...	1
	—
	6"

is not an accurate calculation, unless, as wickedly suggested by some one the other day, the figure at the head of the column is to be reckoned as of cypher value only.

There is something sadly wrong in the following, which I quote from the original article:—

"I employ double poles up to 30 feet in length, except in special cases, fitted together in the form of an inverted V, on straights and slight curves; and single poles with stay and rod on sharp curves, as *the expense of the former is, if anything, cheaper and decidedly stronger to double staying*."

Mr. Gilbert does not, I think, mean that the expense of double poles is cheaper and at the same time "decidedly stronger" than that of double-stayed single poles, although this is how the paragraph reads literally. What he probably wants to declare is that double poles are decidedly stronger than double-stayed single poles; and if such is his contention, I would ask why single poles with one stay are used on sharp curves where the strain is great, and double poles with all their extra strength only on straights and easy curves where the strain is at a minimum? This is indeed a new system of construction, but a queer one.

On the point of cost Mr. Gilbert might give figures showing that double poles—say, 30 feet long—are, "if anything, cheaper" than double-stayed single ones.

If uncreosoted wood is used the cost may be pretty near, but when black wood is employed it will be found, I think, that the balance is to a considerable extent in favour of the double-stayed pole.

Does Mr. Gilbert use white or black poles, and what number of years does he estimate as the average life of each?

Can he give details of or reference to actual and reliable tests indicating the extent of the improvement in insulation said to be obtained by binding wires on the loop principle? Most engineers have decided that the "improvement" is imaginary only, and on straights prefer to bind wires inside to keep them on their respective arms, and clear of wires below, in the event of the binders breaking.

Is it to be understood from the paragraph in reference to the "arm setter and plumb" that arms are set askew on poles put up with "lean or shoulder?" What is the necessity for "lean or shoulder," and how is it regulated?

I don't want to be hard on Mr. Gilbert, although the claim made by that gentleman is, in my opinion, an unwarrantably aggressive and pretentious one; but I must say that his "system" in many respects resembles the bundle of unnecessarily elaborate and expensive arrangements which usually suggest themselves to the puerile conception of youths who have had little or no practical experience on the line. There is nothing special in it, except the expense; and, although I am not the father of a "system," and cannot, therefore, compare notes with Mr. Gilbert, I would recommend him to look round and see if other engineers are not getting the same, and probably better, results by methods less expensive.

Let him give up the idea for a little, that nothing good is being done except on the Highland line, and if his system of "personal survey" will permit of it, come south for a turn round, and he will see lines built in every corner of the kingdom, in which due attention has been paid to the proper proportionment of spans, planes, strains, and angles. He may not see many double poles, as they are not used unless in special circumstances.

When double poles get old, they are sorry substitutes for double stayed single ones. Mr. Gilbert will realise this by-and-bye, and repent of his present practice.

The undulation and ugliness of which he complains and 99 per cent. of the mishaps which occur now and again, are due, as everyone knows, not to defective modern construction, but to want of experience in a previous race of engineers. The old lines are not all wiped out yet, and do give way now and again. Possibly some of them should not have been allowed to run out so far, but the Highland is the only railway company which permits hundreds of pounds to be charged to capital half-yearly for "additional telegraph poles," and where rebuilding and strengthening have to be done at revenue cost alone, it is not surprising that as much life as possible should be taken out of existing lines by the telegraph engineers.

Jno. McDonald.